INTERNATIONAL SCHOOL PRACTICE@JINR

Hands On Electronics

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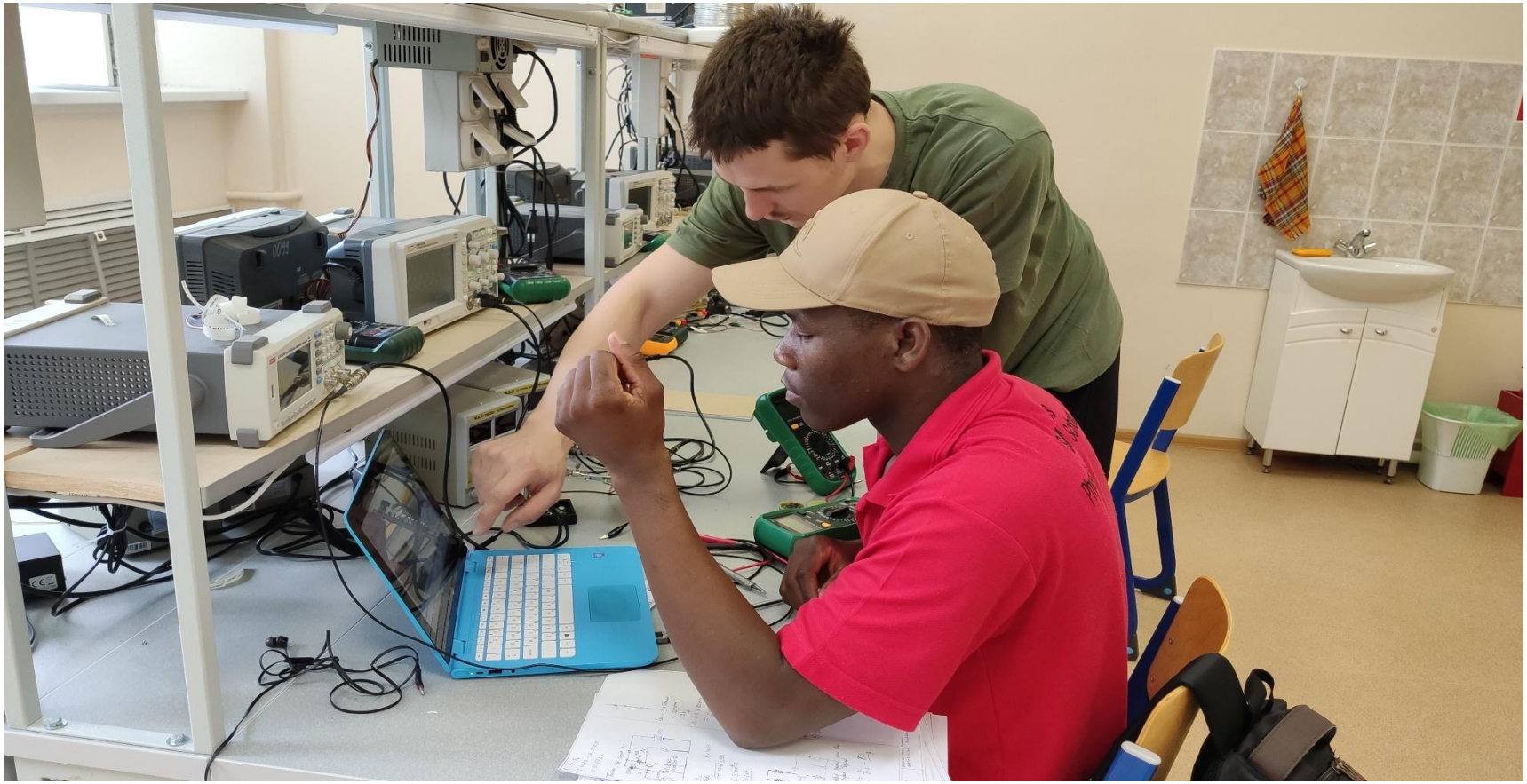
Department:
Science and Technology
REPUBLIC OF SOUTH AFRICA

NRF National Research Foundation | iThemba LABS Laboratory for Accelerator Based Sciences

Hands On Electronics



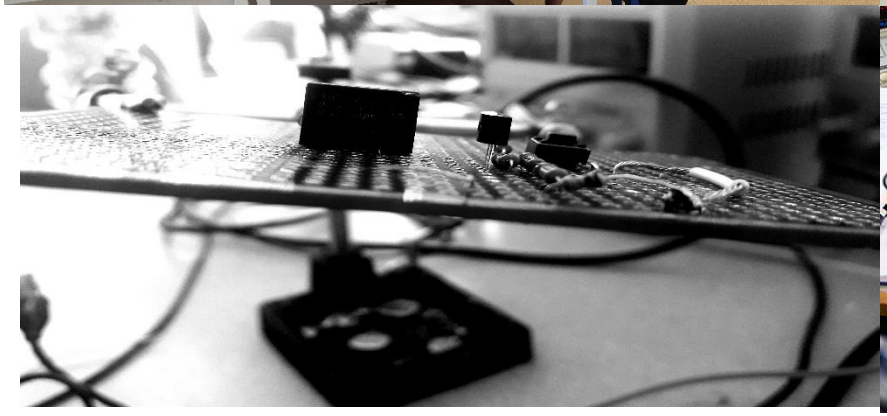
Electronics lab @ JINR University Centre

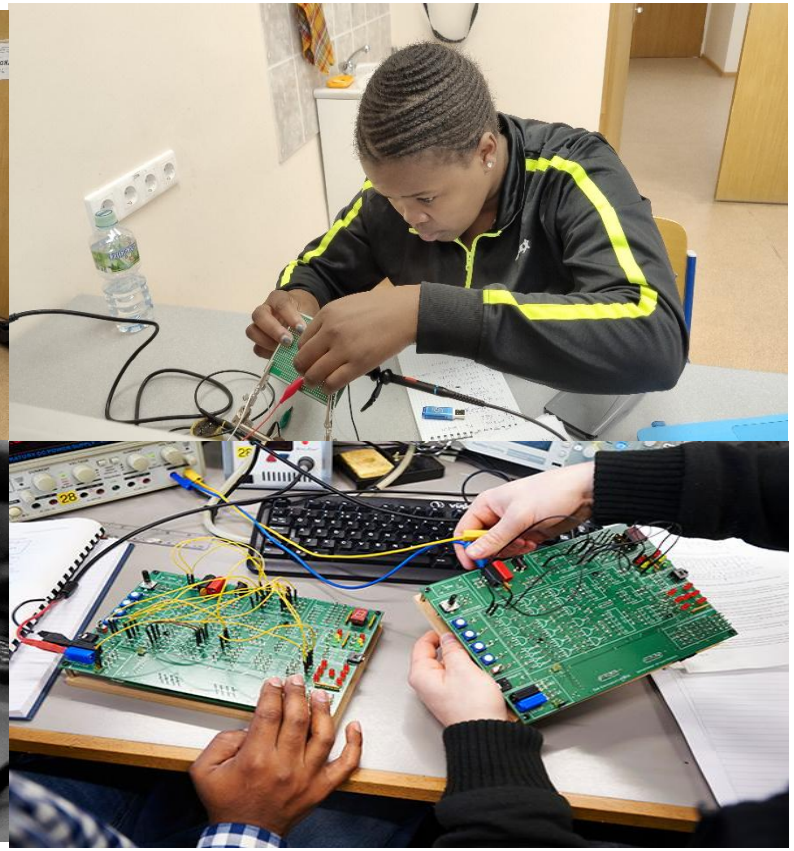
Hands On Electronics

Overview :

- Introduction.
- Aim and objectives
- Literature Review
- Materials and methods(Practical venue, Materials used).
- Results and discussion
- Conclusion
- References
- Acknowledgements
- Questions

introduction





Aim and objectives

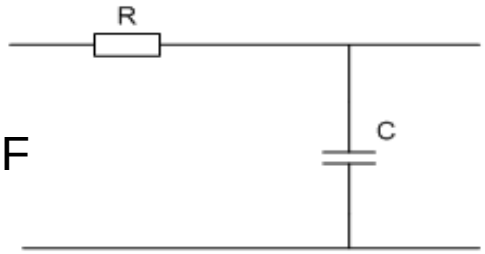
Aim: To experimentally study the main electronic components and circuits.

Objectives:

- ❑To learn about measuring devices and soldering theory.
- ❑To study electronic-elements.
- ❑Calculation of filter parameters.
- ❑To study semi-conductor properties.
- ❑Calculation of transistor amplifier cascades.
- ❑Amplifier testing with cosmic detectors.

Literature review

1. RC Circuits



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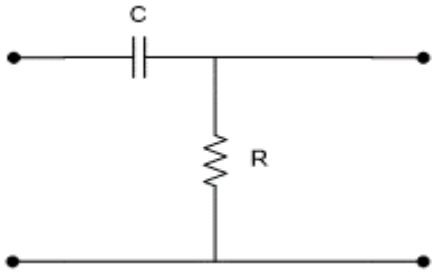


Fig1.2

$$\tau = R \cdot C$$

Fig 1.1

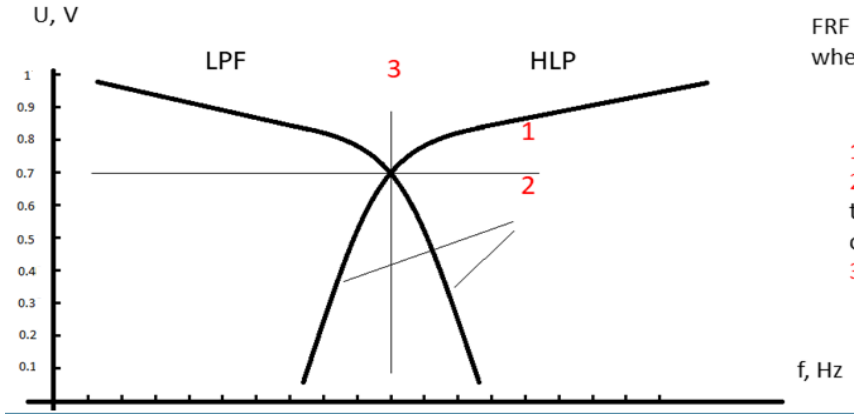


Fig 1.3

Literature review cont.…

- $\tau = RC$ Is called the time constant of the capacitor, i.e. the time it takes the capacitor to be 63% of full charge.
- The capacitor has got an impedance which relates to the cutoff frequency and capacitance as: $X_c = \frac{1}{2\pi f_c C}$

Literature review cont.…

2.Rectifier circuit

Half Wave rectifier

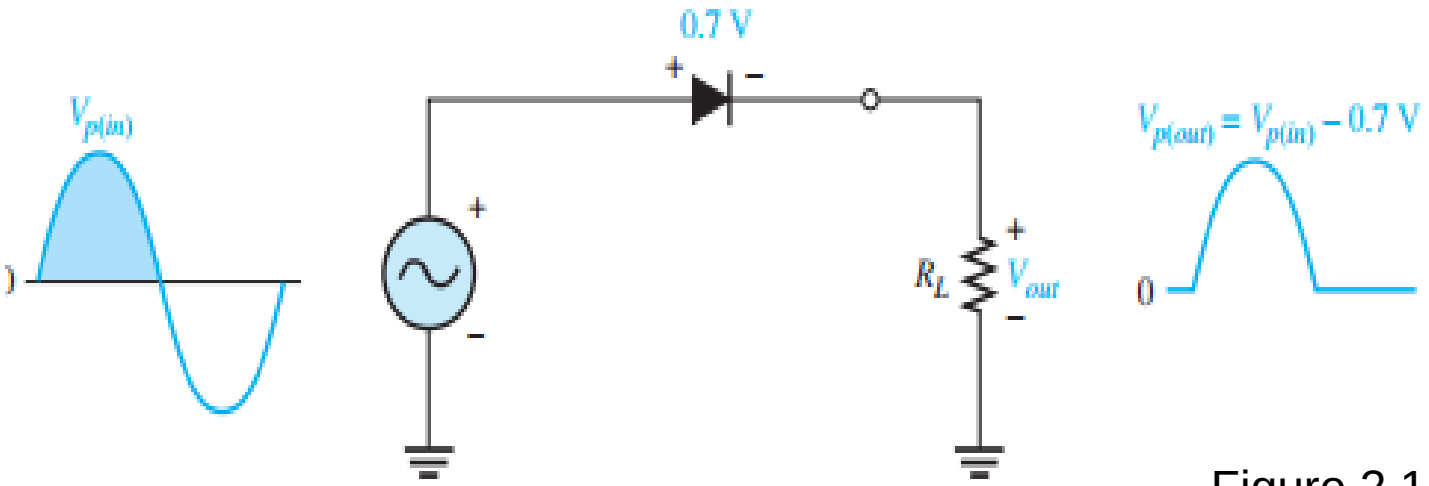


Figure 2.1

Literature review cont.…

Rectifier circuit cont.

Full wave rectifier

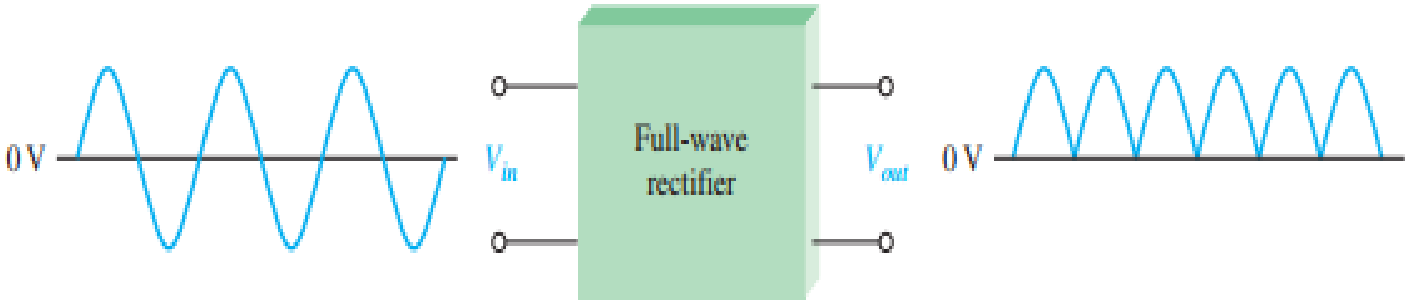


Fig 2.2

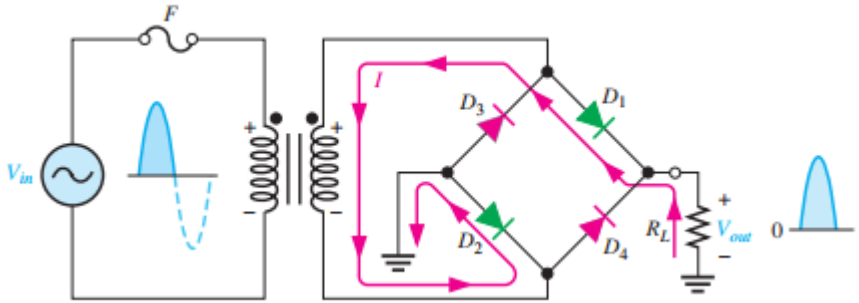
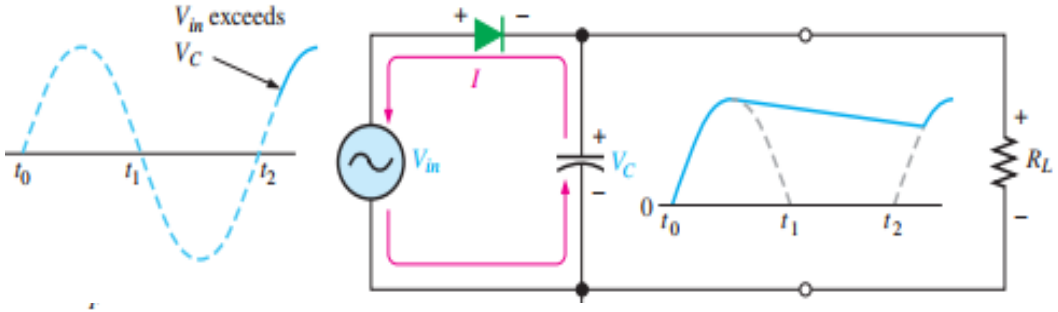


Fig 2.3

Literature review cont.…

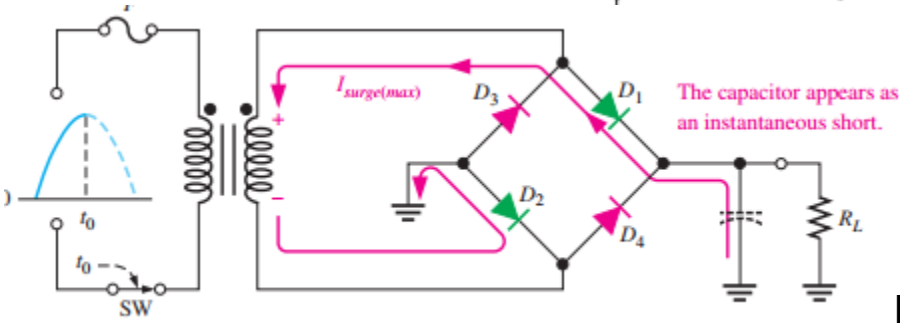
Rectifier circuit cont.

rectifier filter



Half wave filter

Fig 2.4



Full wave rectifier filter

Fig 2.5

Literature review cont.…

3. **Transistor Circuits**

Common-emitter circuit

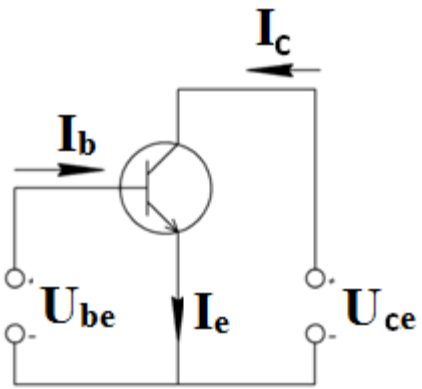


Fig 3.1

Common-collector circuit

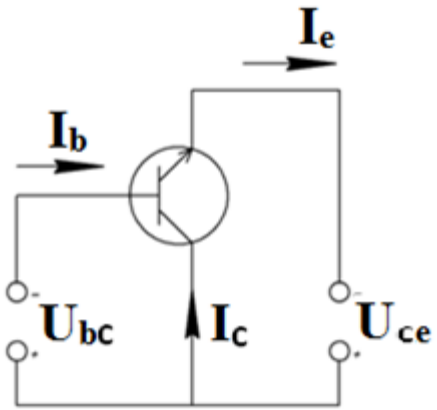


Fig3.2

Common-base circuit

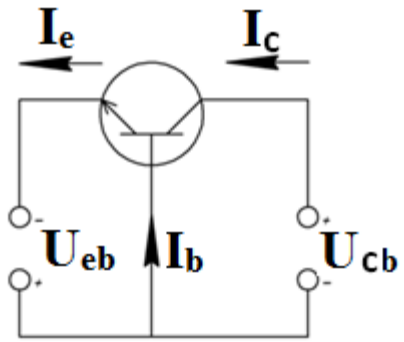


Fig3.3

Literature review cont.…

Transistor Circuits cont.

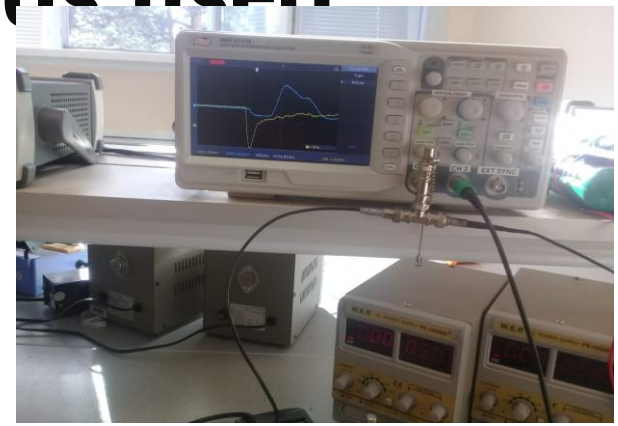
Table 3.1 :Properties of CEC,CCC and CBC

CEC	CCC	CBC
▪ High current gain. ▪ High voltage gain. ▪ Inverted output signal.	▪ High input resistance. ▪ Low output resistance. ▪ High current gain ▪ Low voltage gain	▪ High allowable voltage. ▪ Low output resistance . ▪ High Current gain. ▪ Low voltage gain.

Materials and methods used

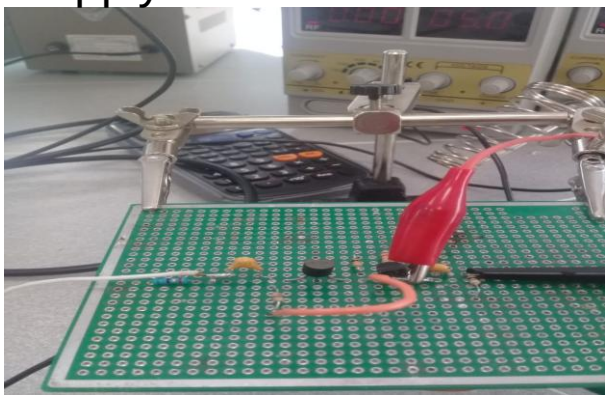
Multimeter/tester

Function generator



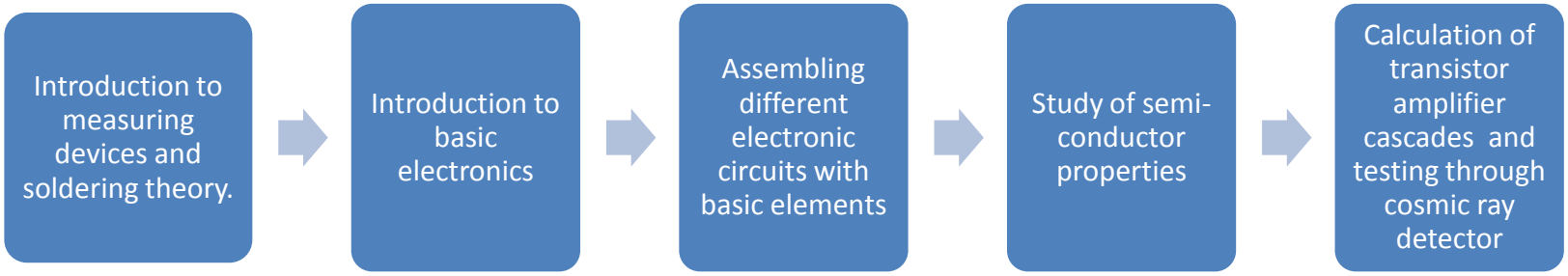
Oscilloscope and DC power supply

Soldering iron



Circuit board and circuit components

Procedure


Introduction to measuring devices and soldering theory.
Introduction to basic electronics
Assembling different electronic circuits with basic elements
Study of semi-conductor properties
Calculation of transistor amplifier cascades and testing through cosmic ray detector

results and discussions

Full Wave rectifier filter

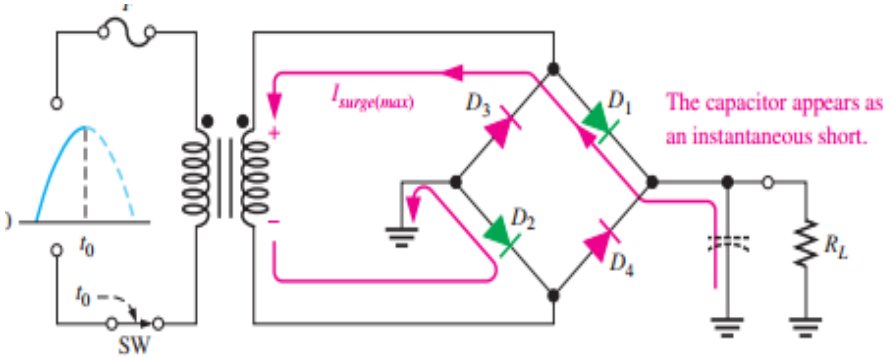


Figure 4.1

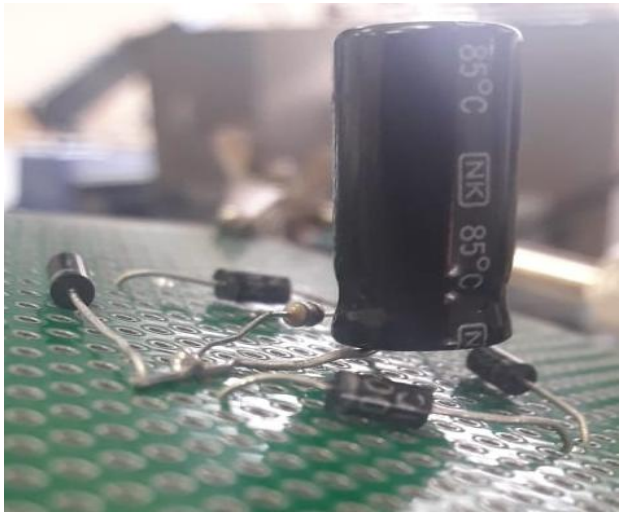


Figure 4.2

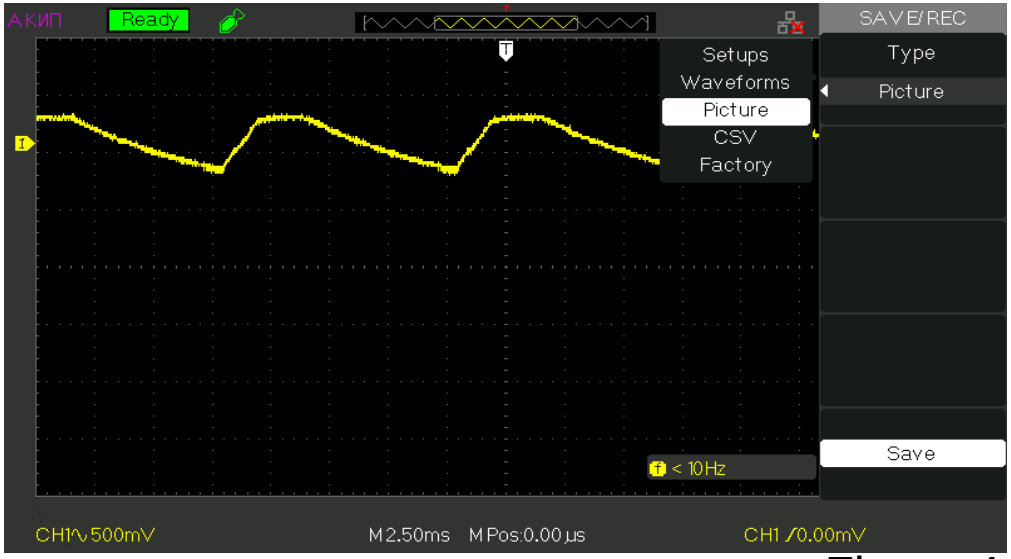
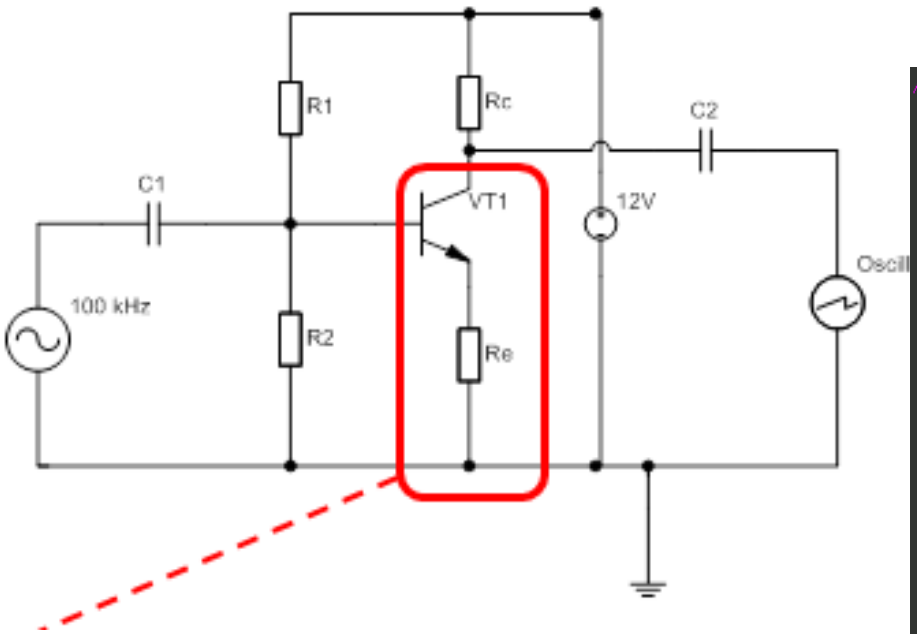


Figure 4.3

results and discussions

Common Emitter Circuit



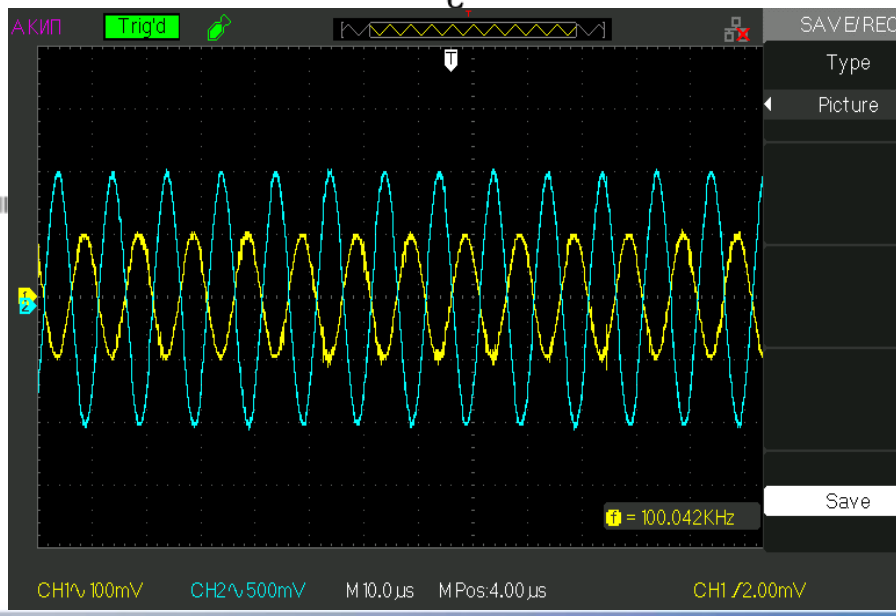
Equations:

$$I_{cmax} = \frac{P_{cmax}}{U_{CE}} \ldots\ldots\ldots\ldots 1$$

$$P_{cmax} = 0.8\, P_{max} \ldots\ldots\ldots 2$$

$$U_{CE} = 0.5 U_S \ldots\ldots\ldots\ldots\ldots 3$$

$$R_c + R_E = \frac{U_{CE}}{I_C} \ldots\ldots\ldots\ldots 4$$



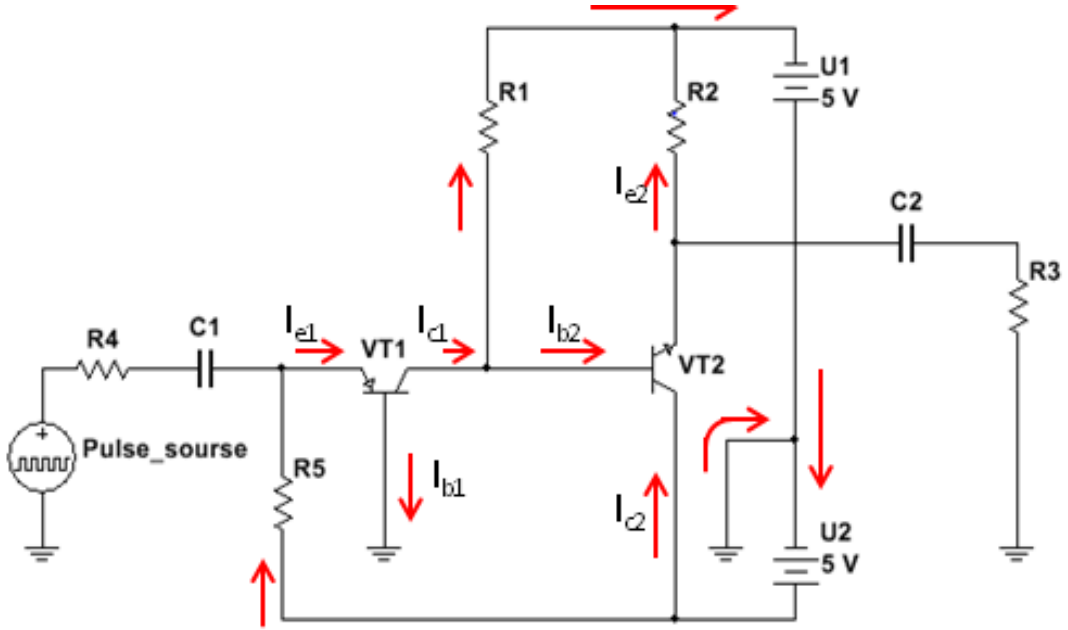
results and discussions

Common Emitter Circuit cont..

- $I_c = 3mA, Chosen.$
- $U_{in} = 200mV$
- $k = \frac{U_{out}}{U_{in}} = 10$
- The signal was inverted and amplified

results and discussions

Preamplifier on CCC and BCC



$$I_{R5} = I_{eVT1} \approx I_{R1} \ldots\ldots\ldots 1$$

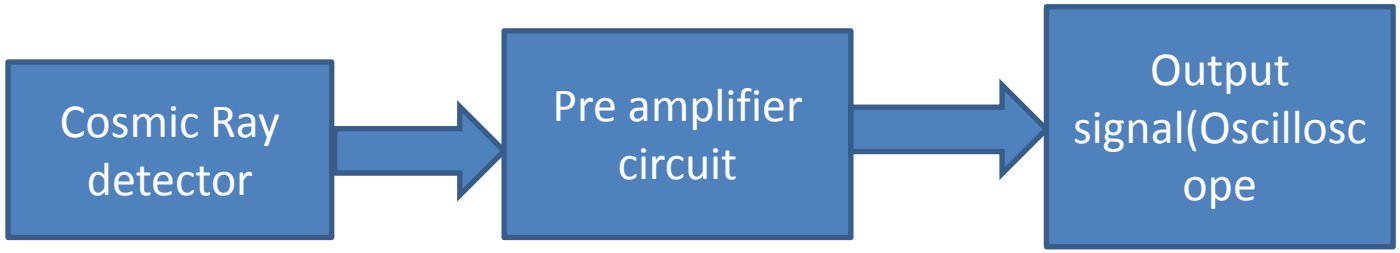
$$I_{R5} = \frac{U2 - 0.7V}{R5} \ldots\ldots\ldots 2$$

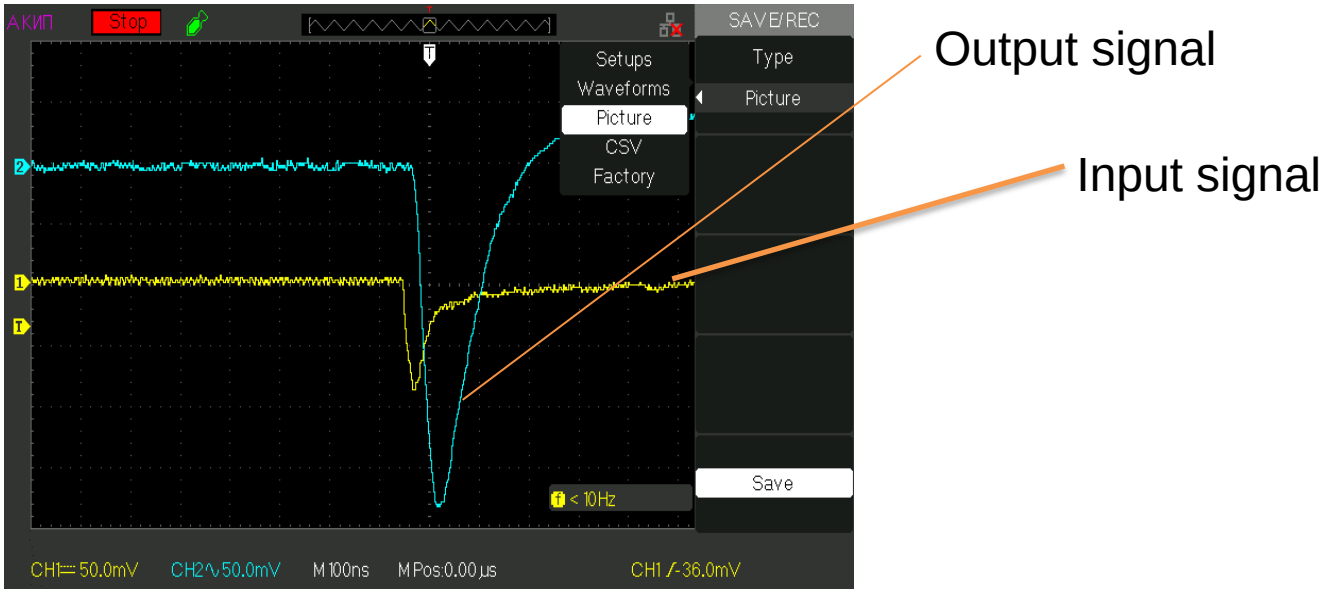
$$R2 = \frac{U1 - U_{eVT2}}{I_{eVT2}} \ldots\ldots 3$$

$$U_{eVT2} = U1 - I_{c1}R1 - U_{beVT2}$$

results and discussions

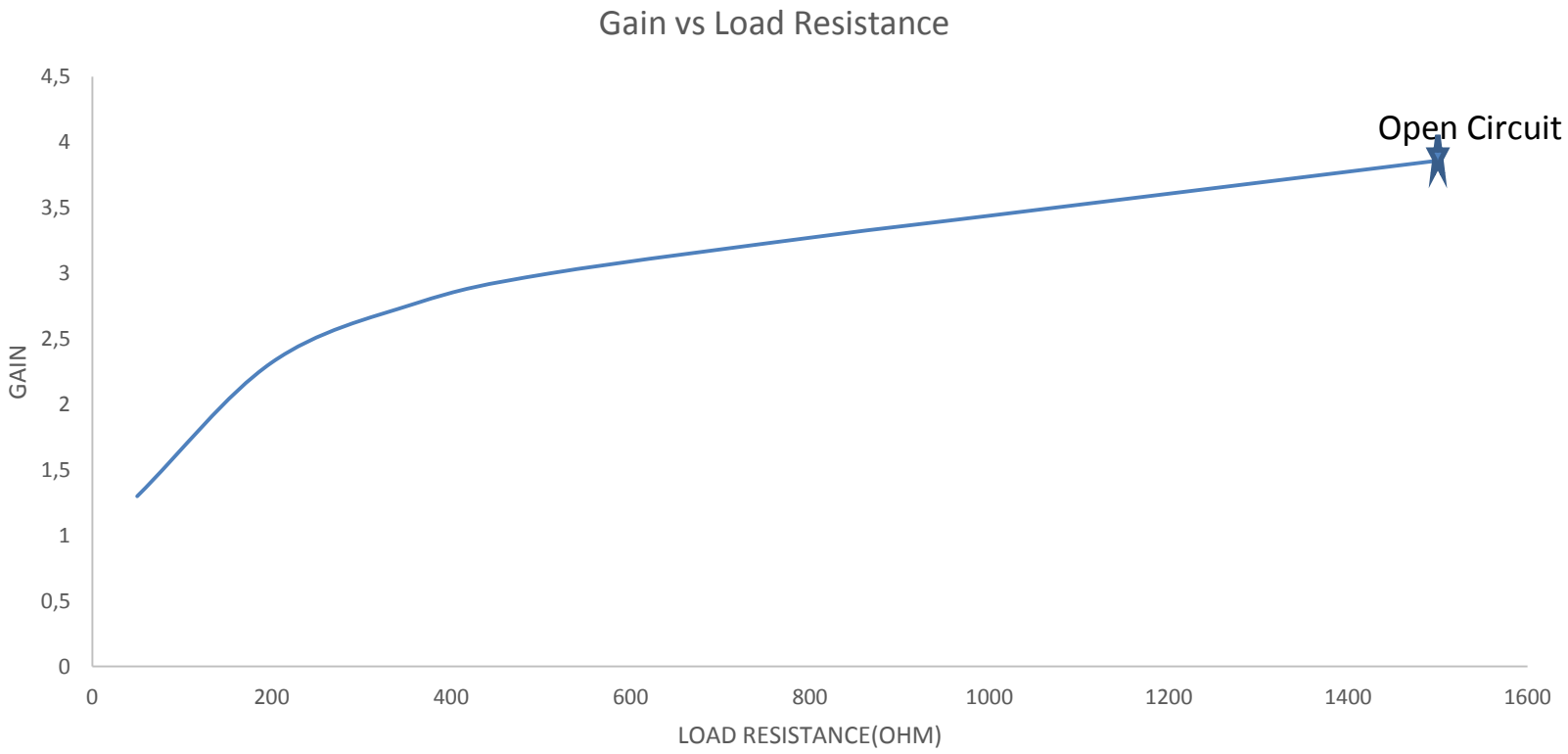
Preamplifier on CCC and BCC cont..





results and discussions

Preamplifier on CCC and BCC cont.



CONCLUSION

- The objectives of this project were achieved since we learnt with understanding, the electronic elements, could perform calculations on high and low pass filters, understood the properties of semi-conductor devices of electronics and could use calculations of transistor amplifiers to connect circuits which were tested on a cosmic ray detector.

references

- Floyd T. L. Electronic devices: conventional current version. – Pearson, 2012.
- Smith R. J., Dorf R. C. Circuits, devices and systems. – John Wiley & Sons, 2009.

Acknowledgements

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THANK
YOU!