NAMIBIA UNIVERSITY
OF SCIENCE AND TECHNOLOGY

**FACULTY OF HEALTH AND APPLIED SCIENCES**

**DEPARTMENT OF NATURAL AND APPLIED SCIENCES**

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| **QUALIFICATION :** BACHELOR OF SCIENCE | |
| **QUALIFICATION CODE:** 07BOSC | **LEVEL:** 7 |
| **COURSE CODE:** ECE602S | **COURSE:** ELECTRICAL CIRCUITS & ELECTRONICS |
| **SESSION:** JANUARY 2019 | **PAPER:** THEORY |
| **DURATION:** 3 Hours | **MARKS:** 100 |

| **SECOND OPPORTUNITY/SUPPLEMENTARY EXAMINATION PAPER** | |
|---|---|
| **EXAMINER** | Dr Munawar Karim |
| **MODERATOR:** | Mr. Vaino Indongo |

**INSTRUCTIONS**

1. Write all your answers in the answer booklet provided
2. Read the whole question before answering
3. Begin each question on a new page.

**PERMISSIBLE MATERIALS**

Non-programmable scientific calculator

**ATTACHMENTS**

None

**THIS PAPER CONSISTS OF 4 PAGES**

(Including this front page)

1) A band-pass filter passes a range of frequencies while blocking signals on either side of the band. Design a low-pass circuit with the 3dB point at 500Hz. Provide a circuit diagram and component values (choose values of R and C). (15)

2) Calculate $^{v_o}/_{v_i}$ as a function of R, C and frequency *f*. Draw a graph of $20\log {}^{v_{out}}/_{v_{in}}$ vs $\log f$. Identify the 3dB point. (15)

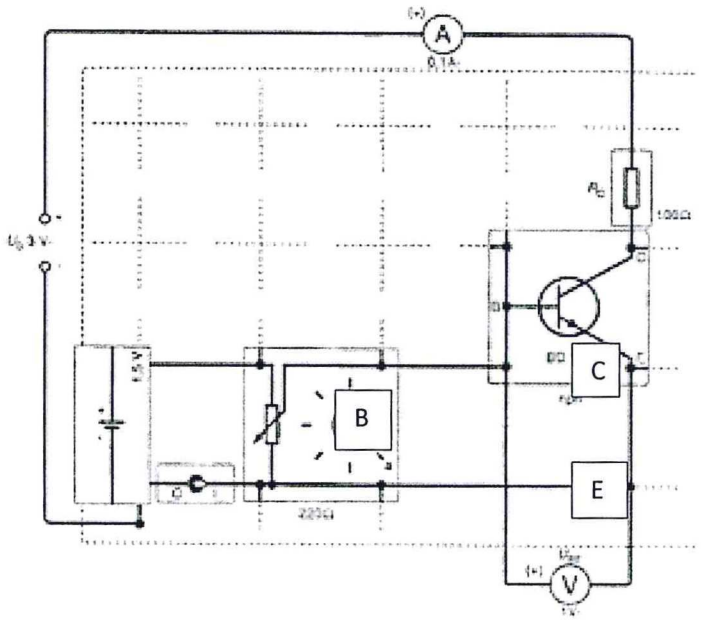
3) Design a high-pass circuit with the 3dB point at 1000Hz. Provide a circuit diagram and. (15) component values (choose values of R and C).

4) Calculate $^{v_o}/_{v_i}$ as a function of R, C and frequency *f*. Draw a graph of $20\log {}^{v_{out}}/_{v_{in}}$ vs $\log f$. Identify the 3dB point. (15)

5) Draw a circuit of a low- and high-pass filters to make a band-pass filter. (15)

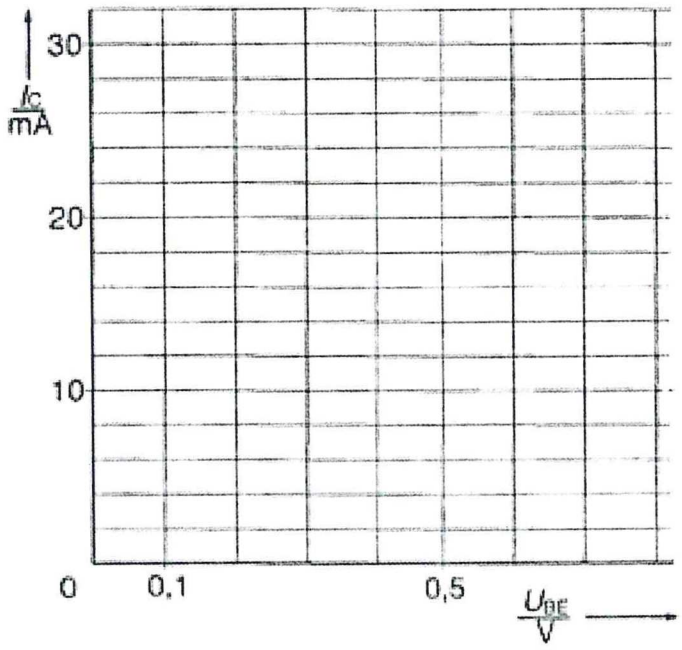
6) A transistor circuit is shown below. (15)

The potentiometer is adjusted for different resistances.




(i) In the table below are recorded measured values of the base voltage $U_{BE}$ and collector current $I_C$. Plot the value pairs $U_{BE}$ and $I_C$ in the graph.

| Step ▶ | 4 | 10 | 11 | 14 |
|---|---|---|---|---|
| Base-emitter voltage $\frac{U_{BE}}{V}$ | Collector current $\frac{I_C}{mA}$ | Voltage drop at resistor $R$ $\frac{U_R}{V}$ | Collector-emitter voltage $\frac{U_{CE}}{V}$ | Collector-emitter resistance $R_{CE} = \frac{U_{CE}}{I_{CE}}$ $\Omega$ |
| 0 | 0 | 0 | 30 | ∞ |
| 0.1 | 0 | 0 | 30 | ∞ |
| 0.2 | 0 | 0 | 30 | ∞ |
| 0.3 | 0 | 0 | 30 | ∞ |
| 0.4 | 0 | 0 | 30 | ∞ |
| 0.45 | 0 | 0 | 30 | ∞ |
| 0.50 | 0 | 0 | 30 | ∞ |
| 0.55 | 0 | 0 | 30 | ∞ |
| 0.60 x | 1.0 | 0.1 | 2.9 | 2900 |
| 0.65 | 6.0 | 0.6 | 2.4 | 400 |
| 0.70 | 20 | 2.0 | 1.0 | 50 |
| 0.75 x | 30 | 3.0 | 0 | 0 |
| 0.80 | 30 | 3.0 | 0 | 0 |

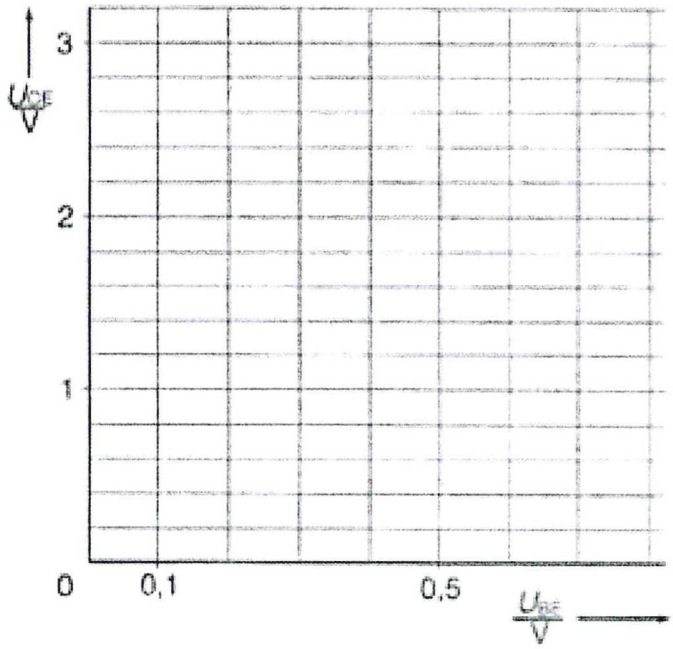



(ii) At what voltage $U_{BE1}$ does the collector-emitter path of the transistor become conductive?

(iii) At what value $U_{BE2}$ does the collector current $I_C$ stop changing?

(iv) Why does $I_C$ not increase any further? Hint: there is a 100Ω resistor in series with the collector.

(7) (i) Draw the graph for $U_{CE}$ as a function of $U_{BE}$ in the graph below, using information on the table above. (10)




(ii) Calculate the slope of the characteristic in the middle between $U_{BE1}$ and $U_{BE2}$. This is the working voltage of the transistor.

(iii) For which base-emitter voltages is the transistor an insulator, and for which voltages is it a conductor?