



# MERU UNIVERSITY OF SCIENCE AND TECHNOLOGY

P.O. Box 972-60200 – Meru-Kenya.

Tel: 020-2069349, 061-2309217. 064-30320 Cell phone: +254 712524293, +254 789151411

Fax: 064-30321

Website: [www.must.ac.ke](http://www.must.ac.ke) Email: [info@mucst.ac.ke](mailto:info@mucst.ac.ke)

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## University Examinations 2012/2013

SECONDYEAR, FIRST SEMESTER EXAMINATIONS FOR THE DEGREE OF  
BACHELOR OF SCIENCE IN COMPUTER SCIENCE, FIRST YEAR, SECOND  
SEMESTER FOR BACHELOR OF SCIENCE IN MATHEMATICS AND COMPUTER  
SCIENCE AND BACHELOR OF SCIENCE IN INFORMATION TECHNOLOGY

### ICS 2200: ELECTRONICS

DATE: APRIL 2013

TIME: 2 HOURS

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INSTRUCTIONS: Answer question *one* and any other *two* questions

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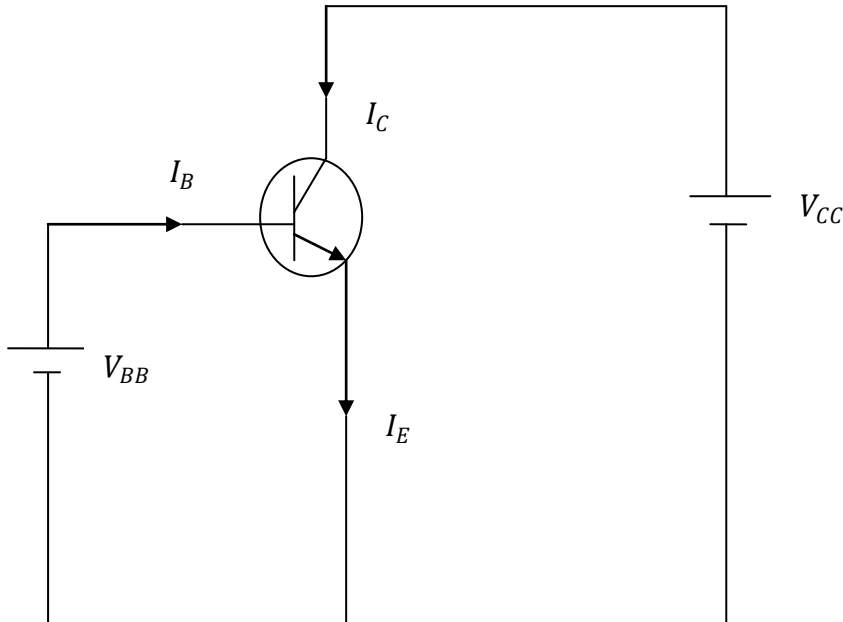
#### QUESTION ONE (30 MARKS)

- a) Draw the symbols of n – channel and p – channel MOSFET's transistors and label their terminals. (4 Marks)
- b) Explain the following terms as used in solid state electronics;
  - i. Acceptor atoms
  - ii. Donor atoms. (2 Marks)
- c) Describe how p – type and n – type semiconductors are formed. (4 Marks)
- d) Sketch the circuit diagram showing the p – n junction diode when;
  - i. Forward biased
  - ii. Reversed biased (4 Marks)
- e) Describe the following types of diodes and state their applications
  - i. Zener diode (2 Marks)
  - ii. Tunnel diode (2 Marks)
  - iii. Photo diode (2 Marks)
- f) State the difference between the;
  - i. BJT and MOSFET transistor (1 Mark)
  - ii. BJT and J FET transistor. (1 Mark)
- g) State two pure semi conductor materials. (2 Marks)
- h) Sketch the standard symbol of an OP-AMP and label its terminals. (2 Marks)
- i) Explain why transistors are applied in OP-AMPs. (2 Marks)
- j) In an experiment to study transistor characteristics in common emitter mode, which transistor parameters are kept constant during;

- i. Input characteristics (1 Mark)
- ii. Output characteristics. (1 Mark)

**QUESTION TWO (20 MARKS)**

a) **Figure 1** shows a BJT transistor in active mode;



**Figure 1: Transistor in active mode**

Show using the transistor circuit that

$\alpha_{dc} = \frac{B_{dc}}{1+B_{dc}}$ , where  $\alpha_{dc}$  and  $B_{dc}$  are transistor parameters. (7 Marks)

- b) Distinguish between intrinsic and extrinsic semi conductors. (2 Marks)
- c) With a well labeled circuit diagram, explain how a bridge rectifier works. Sketch its output when connected to a C.R.O with and without the capacitor across the load. (8 Marks)
- d) Explain how holes in a doped semi conductor are able to transfer charge carriers. (3 Marks)

**QUESTION THREE (20 MARKS)**

- a) Discuss the two basic forms of MOSFETs available and sketch their symbols for both n- channel and p – channel. (8 Marks)
- b) What is the function of the substrate terminal in a MOSFETs. (2 Marks)
- c) Given the following values of  $V_{GS}$ ,  $0V, 1.0V, 2.0V, 3.0V, 4.0V$  and  $5.0V$ . Sketch the  $I_D - V_{DS}$  characteristics of the MOSFETs that was used in the experiment.(6 Marks)
- d) In the  $I_D - V_{DS}$  characteristics in 3(c) indicate; the ohmic and saturation region. (4 Marks)

#### QUESTION FOUR (20 MARKS)

- a) Sketch a circuit that will be used to study the input characteristics of a common emitter transistor. Indicate clear where the ammeters and voltmeters will be placed using their symbols in the circuit. (4 Marks)
- b) If the input (transfer) characteristics of a common emitter transistor was studied at five instances of  $V_{CE}$ , then sketch the input characteristics in one graph if;  
 $V_{CE1} < V_{CE2} < V_{CE3} < V_{CE4} < V_{CE5}$  (5 Marks)
- c) Why is pure semiconductor an insulator at room temperature but a conductor at higher temperatures? (3 Marks)
- d) Given  $\beta = 99$  for a transistor, determine its  $\alpha$ , both dc parameters. (3 Marks)
- e) With reference to 3(b), if the output characteristics were also studied with five instances of  $I_B$ , sketch the characteristics in one graph if  
 $I_{B1} < I_{B2} < I_{B3} < I_{B4} < I_{B5}$  (5 Marks)

#### QUESTION FIVE (20 MARKS)

- a) Using energy band theory, distinguish between insulators, conductors and semi conductors. (6 Marks)
- b) Describe with the help of symbols the three configurations of OP-AMP. (6 Marks)
- c) With a well labeled circuit diagram, explain how a bridge rectifier works. Sketch its output when connected to a C.R.O with and without the capacitor across the load. (6 Marks)
- d) Explain why the depletion layer in a p – n junction diode reduces when forward biased. (2 Marks)