TECHNICAL UNIVERSITY OF MOMBASA

FACULTY OF APPLIED SCIENCES
MATHEMATICS AND PHYSICS DEPARTMENT
UNIVERSITY EXAMINATION FOR BACHELOR OF TECHNOLOGY DEGREE IN

APPLIED PHYSICS (BTAP)

EEE 4250: ANALOGUE ELECRONICS

END OF SEMESTER EXAMINATION

SERIES: May Series 2016:

TIME: 2 HOURS **DATE: May 2016**

Instructions to Candidates

You should have the following for this examination
-Answer Booklet, examination pass and student ID
- This paper consists of **FIVE** questions. Attempt Question **ONE** and any other **TWO** questions.
- Do not write on the question paper.
- Marks may be awarded for clear work showing steps followed.
- The following **constants** and **h -parameters** may be useful:

i) Transistor **2N3904** h-parameters:

- $h_{11} = 3.5\text{k}\Omega$; $h_{11} = 1.3 \times 10^{-4}$; $h_{21} = 120$; $h_{22} = 85\mu\text{S}$

ii) Conversion to CB amplifier parameter

- $h_{ib} = \frac{h_{ie}}{D}$
- $h_{eb} = \frac{h_{ie}h_{oe} - h_{re}(h_{fe})}{D}$
- $\text{D}\,h_{fb} = \frac{h_{fe}(1-h_{re}) - h_{ie}h_{oe})}{D}$
- $D = (1+h_{fe})(1-h_{re}) + h_{ie}h_{oe}$

QUESTION ONE (30MKS)

a) (i) What is a P-N junction? (1mk)
(ii) Sketch a labeled diagram to show a simple P-N junction. (2mks)
(iii) Explain how to forward bias a PN junction. (2mks)
(iv) Explain how to reverse bias a PN junction. (2mks)
(v) What is a diode? (2mrks)

b) (i) What is an operational amplifier? (1mk)
(v) An operational amplifier has a voltage gain of 500 which falls to 100 when a negative feedback is applied. Calculate the feedback fraction, m. (4mks)

c) (i) Explain what is meant by positive feedback of an operational amplifier. (1mk)

(ii) State four effects of positive feedback. (4mks)

d) (i) What is an oscillator? (1mk)

(ii) Differentiate between a damped oscillator and an undamped oscillator. (4mks)

e) (i) Give any two h-parameters used to analyze a two port unloaded linear network of transistors. (2mks)

(ii) Explain how the h-parameters you have given above are obtained. (4mks)

QUESTION TWO (20MKS)

a) What happens inside the p-n Junction Diode? (4mks)

b) Using a sketch diagram;

(i) Explain what happen when the diode is forward biased? (5mks)

(ii) Explain what happens in the Reverse biased? (5mks)

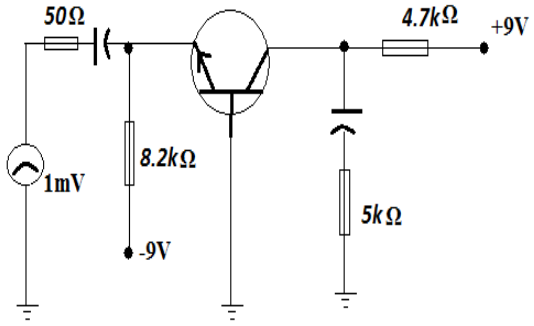
c) (i) What is a solar cell? (2mks)

(ii) Using a sketch diagram explain how a solar cell operates. (4mks)

QUESTION THREE (20MKS)

The circuit below is of a CB transistor amplifier. Study it and use it to answer the questions that follow. Given that the amplifier has a quiescent collector current of about 1mA, use the h-parameters for **2N3904** to determine;

(a) A_i **;** $\mathbf{A_v}$**;** A_i $\mathbf{Z_{in}}$ and $\mathbf{Z_{out}}$ for this amplifier. (12mks)



b) If the h-parameter of the transistor were for CE configuration as follows: $h_{ie} = 1000\Omega$**;** $h_{re} = -3.5\times10^{-4}$**;** $h_{fe} = 55$ and $h_{oe} = 20\mu S$. Find the current gain**,** A_i and voltage gain, A_v if r_L **=2kΩ**. (8mks)

QUESTION FOUR (20MKS)

a) (i) What is a field Effect Transistor? (2mks)

(ii) Sketch a labeled circuit symbol of a Field Effect Transistor. (2mks)

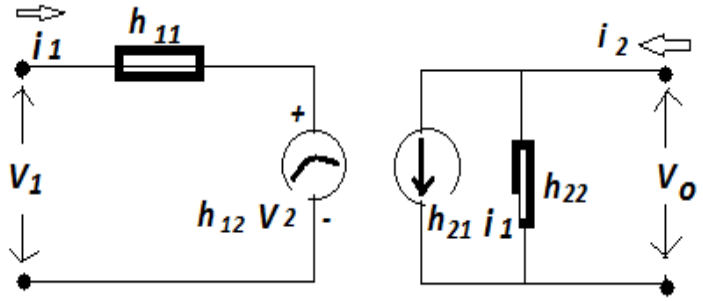
(iii) What is a bipolar transistor? (2mks)

(iv) State one use of a bipolar transistor. (1mk)

(v) Give any two types of Bipolar transistors. (2mks)

(vi) What is a Solar cell? (1mk)

b) Study the hybrid model shown below. The circuit demonstrates h-parameter analysis of a transistor network.



(i) Given that, $V_1 = 35.2mV$ while $i_1 = 0.013mA$, determine h_{11}. (2mks)

(ii) Given that, $i_2 = 1.6mA$ and $i_1 = 0.03mA$, determine h_{21}. (2mks)

c) What are the following power electronic devices:

i. Diac . (1mk)

ii. Triac. (1mk)

iii. Thyristor. (1mrk)

iv. Silicon controlled rectifier. (1mrk)

v. Gate-Turn-Off switch. (1mk)

vi. Uni-junction transistor. (1mk)

QUESTION FIVE (20MKS)

a) (i) Differentiate between a positive and a negative feedback. (2mks)

(ii) Give two ways in which negative feedback can be classified. (1mk)

b) In a class A transistor operation amplifier, the Q-point is located at 200mA, 10V. When a signal is applied, the collector current swings between 440mA and 40mA while the voltage swings between 12V and 1 V respectively. Find the ;

i. Output AC power (3mks)

ii. Output AC power (3mks)

iii. Efficiency (3mks)

iv. Power dissipated (2mks)

c) A germanium transistor has a thermal resistor at its junction as $0.33^0C/mW$ and the apparent temperature is 28^0C. Calculate;

(i) the maximum power dissipation that can be allowed without heat sink. (3mks)

(ii) the maximum power that can be allowed if a heat sink is used which reduces the thermal resistance of the transistor to $0.09\ ^0C/mW$. (3mks)

END