CHUKA  **UNIVERSITY**

UNIVERSITY EXAMINATIONS

EXAMINATION FOR THE AWARD OF DEGREE OF BACHELOR OF SCIENCE (PHYSICS) AND BACHELOR OF EDUCATION (SCIENCE)

PHYS 423: ANALOGUE ELECTRONICS

STREAMS: Y4S2 BSC (GEN)BED (SC) **TIME: 2 HOURS**

DAY/DATE: TUESDAY 10/04/2018 **2.30 P.M – 4.30 P.M**

INSTRUCTION:

- **Answer question one and any other two questions**

Question one (30 marks)

(a) Explain why the base of a BJT transistor is lightly doped while the emitter is heavily doped. (2marks)
(b) What do you understand by the term "biasing" in transistors (1mark)
(c) Differentiate between voltage follower and differential amplifier (2marks)
(d) With the help of circuit diagrams, discuss the three basic configurations of the operational Amplifiers (OPAMPS) (3marks)
(e) The transistor from a p and n type semiconductor doesn't conduct at 0 V but slight above this value (0.7 V for silicon). Explain this observation (3marks)
(f) How is the resistance of a semiconductor material as compared to that of a metal (2marks)
(g) Discuss the output transfer characteristics (I_C –V_{CE}) of a BJT transistor for various V_{BE} (4marks)
(h) Explain the terms modulation and demodulation as used in electronics (2marks)
(i) A transistor amplifier has a gain that varies with frequency. Explain this observation with a curve (Bode plot) (3marks)
(j) Class B power amplifiers have zero current when the input signal is zero. With a circuit symbol, explain how it is designed and show its output (5marks)
(k) Differentiate between JFET and BJT transistors from their design point of view (3marks)

Question two (20 marks)

(a) Figure 2.1 shows an operational amplifier circuit that was used in the input stage of a loudspeaker. The source voltage (V_{in}) is sinusoidal and there are no distortion of the output voltage (V_{out}) .

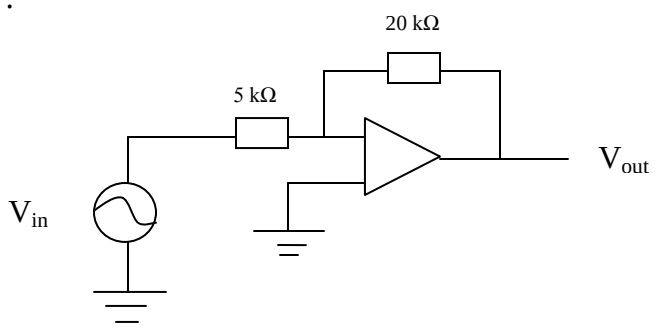

Figure 2.1. Operational amplifier circuit

(i) Sketch the waveform for the output voltage in relation to that of the input voltage. Explain your answer. (3marks)

(ii) Calculate the voltage gain of this amplifier configuration (3marks)

(b) Class B push pull amplifiers are known to have cross over distortion problems. With the help of a waveform, discuss the effect of this problem in sound producing devices ie loudspeaker (6marks)

(c) With a well labeled circuit diagram, show the circuit symbol of n-channel and p-channel MOSFET (4marks)

(d) For high amplification, a multistage transistor amplifier is preferred. Describe how this is designed (4marks)

Question three (20 marks)

(a) With circuit diagrams, describe how an operational amplifier is configured as an integrator and a differentiator (6marks)

(b) Figure 3.1 shows a two stage current amplifier used in a sensor circuit with BJT transistors Tr_1 and Tr_2.

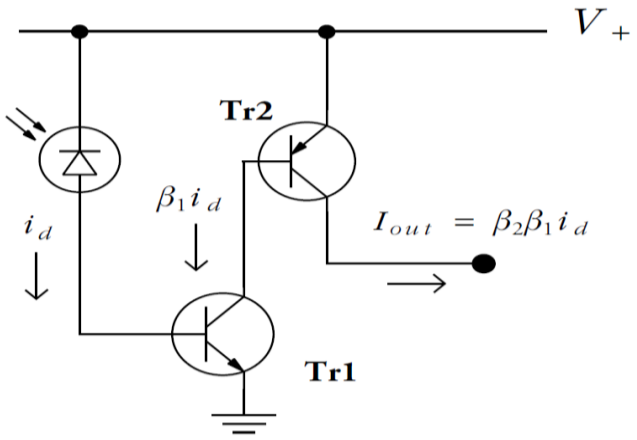

Figure 3.1. A two stage current amplifier based on BJT transistors.

(i) Briefly explain how the current i_d is generated in the circuit when light falls on the given diode as shown. (3marks)

(ii) What is the purpose of V+ voltage connected to the transistor Tr_2 and the diode. (2marks).

(iii) Given $\beta_1 = 200$ and $\beta_2 = 100$, calculate the gain of the two stage current amplifier (4marks

(iv) Describe one practical application of the above circuit in security surveillance with slight addition of electronics components if any (3marks)

(c) An OPAMP can be applied as a summing amplifier. Describe how this is designed. (2marks)

Question four (20 marks)

(a) An n-p-n transistor circuit is given in figure 4.1 with β= 100 and the transistor is made of silicon ie V_{BE} = 0.7 V.

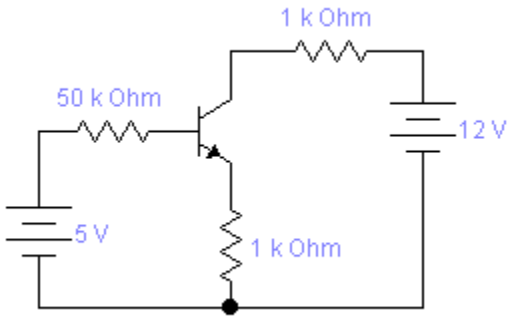

Figure 4.1. n-p-n transistor circuit.

Compute the following parameters for the given transistor

(i) I_B (4mks)
(ii) I_C (2mks)
(iii) I_E (2mks)

(iv) V_{CE} (3mks)

(b) With a well labeled diagram, describe how the following diodes operate: Shotky diode, Zener diode and tunnel diode (6marks)

(c) Explain why intrinsic semiconductor doesn't conduct electricity at room temperature . (3marks)

Question five (20 marks)

(a) Figure 5.1 shows a bipolar junction transistor amplifier circuit that was used in the input stage of a sensor. If the source voltage (V_{in}) is equal to V_B, show that, the voltage gain of this amplifier is given by $-R_C/R_E$. (8marks)

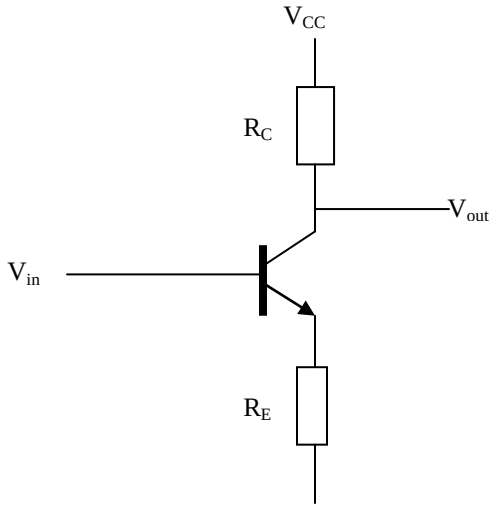

Figure 5.1. BJT amplifier circuit

(b) With a well labeled diagram, describe how a junction field effect transistor with n-channel is constructed (6marks)

(c) Discuss the input characteristics (I_B –V_{BE}) of a BJT transistor for various V_{CE} (4marks)

(d) An OPAMP can be applied as a integrator amplifier. Describe how this is designed (2marks)
