



MDK

UNIVERSITY OF ENERGY AND NATURAL RESOURCES, SUNYANI, GHANA

SCHOOL OF ENGINEERING

DEPARTMENT OF COMPUTER AND ELECTRICAL ENGINEERING

Level 300: First Semester Examinations 2019/2020

Bachelor of Science (Computer Engineering, Electrical & Electronic Engineering)

ELNG 303: LINEAR ELECTRONIC CIRCUITS

DECEMBER, 2019

Time: 2½ hours

INSTRUCTIONS: ANSWER ALL FOUR QUESTIONS)

Question One [3+(2+4)+4=13]

- a) With the aid of diagrams, briefly describe the process of photolithography used in the fabrication of monolithic ICs.
- b) A circuit is built around a bi-polar NPN transistor. The base network has a diode and a capacitor in series while the collector is connected to a power supply through a resistor. If the emitter is connected to ground:
- Draw the circuit
  - Provide all the masking layout of the circuit
- c) Fig1.1 shows a p-diffusion resistor fabricated with a sheet resistance of 120 Ohm per square. The corners and the pads are estimated to have 0.6 of the value of a regular sheet resistance. Find the value of the resulting resistor.

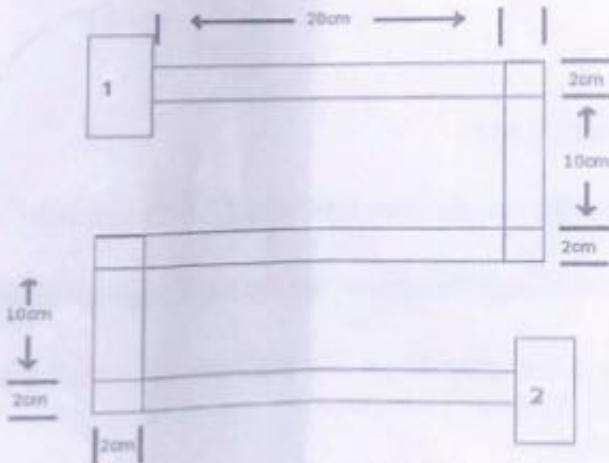


Fig1.1

**Question Two [2+4+6+6=18]**

- a) Mention the characteristics of an ideal op-amp.
- b) Draw a shunt regulator and clearly show the four main elements. Derive an expression for the output voltage.
- c) A differential amplifier has an output voltage given by  $V_o = 9 V_1 - 10V_2$ . The two inputs are  $V_1 = 10 \text{ mV}$  and  $V_2 = 20 \text{ mV}$ . Determine common mode input voltage, common mode gain and the differential gain.
- d) In Op-Amp circuit of Fig. 2.1, find  $V_o$  in terms of  $V_1$  and  $V_2$  assume the ideal op amp model. Find an expression for  $V_o$ . If  $V_{11} = 1.5\text{V}$  and  $V_2 = 3.0\text{V}$ , find  $V_o$  for  $R_1 = 1\text{k}\Omega$  and  $R_2 = 2\text{k}\Omega$

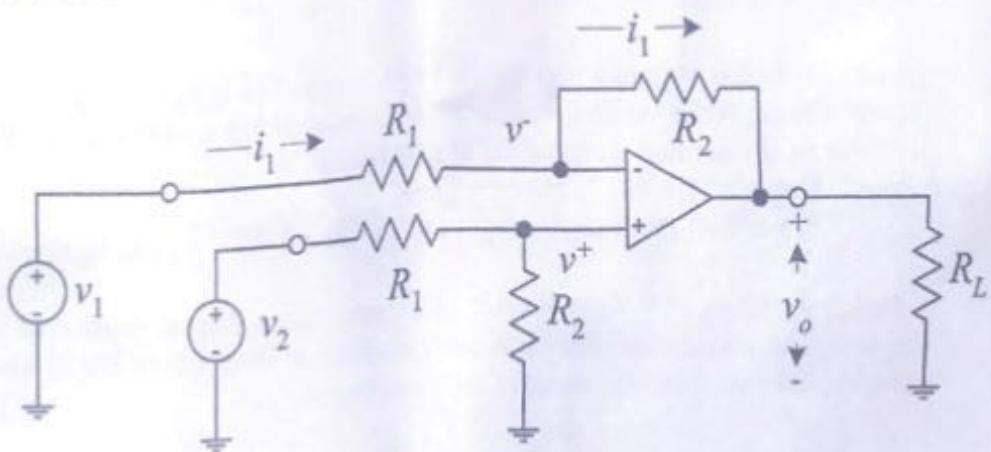


Fig 2.1

**Question Three [2+4+(2x3)=12]**

- a) State and explain the various classifications of power amplifiers.
- b) For a class B power amplifier, show that the maximum efficiency is 78.5%.
- c) For a class B amplifier providing a 20V peak-to-peak signal to an  $8 \Omega$  speaker and a power supply of  $V_{cc} = 15\text{V}$ , determine:
- i) Input power
  - ii) Output power
  - iii) Circuit efficiency

# MDK

Question Four [4+4+(3x3) =17]

Consider the common-emitter BJT amplifier circuit shown in Figure 4.1. Take  $\beta_1 = \beta_2 = 200$ ,  $V_{BE} = 0.7V$  and thermal voltage as  $26V$ . Answer the following questions.

- (a) Determine the emitter current  $I_{E2}$ ,  $I_{E1}$  and hence  $r_{e2}$  and  $r_{e1}$
- (b) Draw the AC equivalent circuit and determine:
  - i) Input impedance,  $Z_1$ ,  $Z_2$  and  $Z_{in}$
  - ii) Gain of the transistor,  $A_{v2}$  and  $A_{v1}$
  - iii) Output voltage gain with signal,  $A_{vs}$

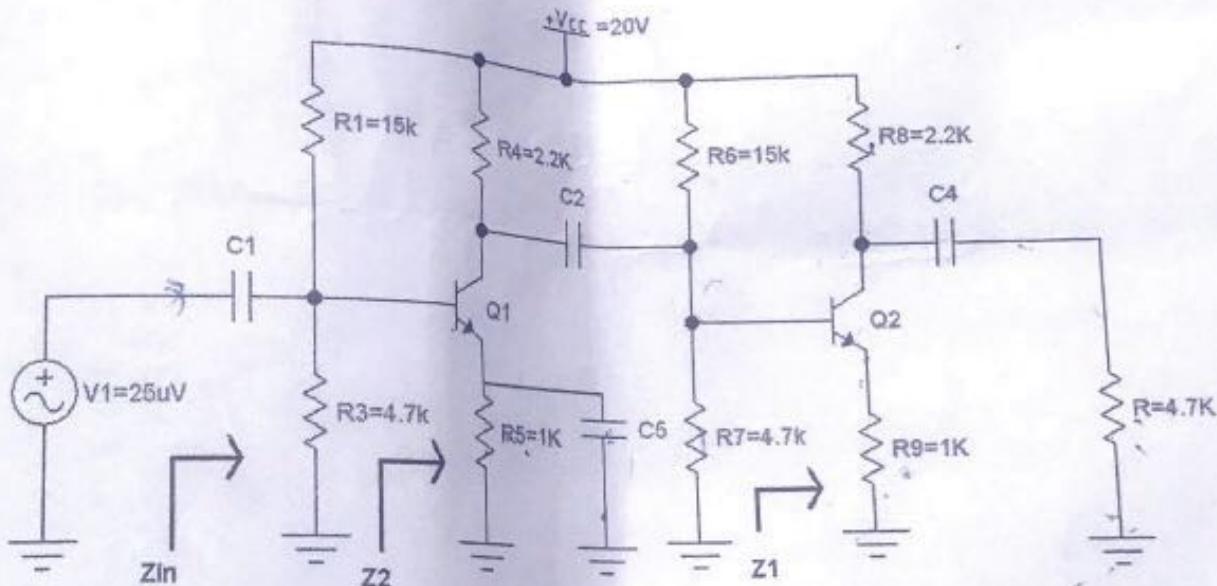


Fig. 4.1