UNIVERSITY OF ESWATINI

FACULTY OF SCIENCE & ENGINEERING

DEPARTMENT OF ELECTRICAL & ELECTRONIC ENGINEERING

RESIT EXAMINATION

JANUARY 2020

TITLE OF PAPER: ANALOGUE ELECTRONICS II

COURSE CODE: EEE421

DURATION: 3 HOURS

INSTRUCTIONS:

1. There are five (5) questions in this paper. Answer any FOUR (4) questions.
2. Each question carries 25 marks.
3. Start each question in a new page.

This paper should not be opened until permission has been given by the invigilator.

This paper contains seven (7) pages including this page.

QUESTION ONE (25 marks)

A circuit of a differential amplifier is shown in Figure-Q1.

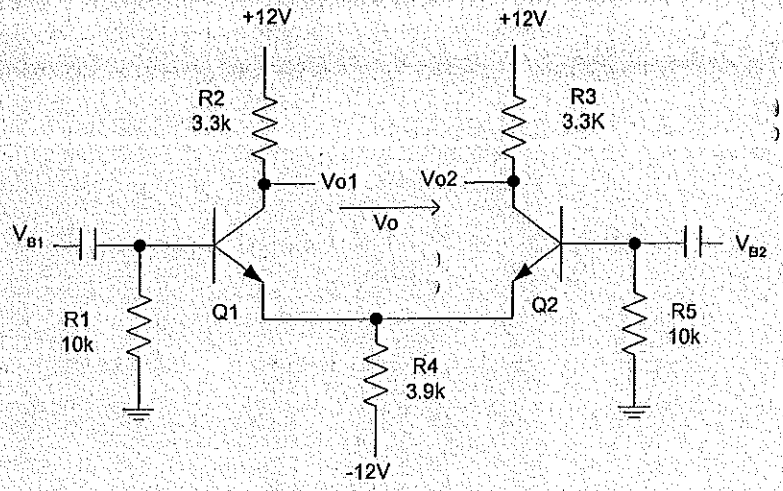

Figure - Q1

(a) If the transistors are of high gain type and matched, find the collector currents of the two transistors at no signal. What the voltages at the collectors and at the emitters?

(6 marks)

(b) (i) When a differential input signal v_d is applied to the circuit, derive the expressions drawing differential half circuits for the voltage gains $\frac{v_{01}}{v_d}$, $\frac{v_{02}}{v_d}$ and $\frac{v_o}{v_d}$.

(6 marks)

(ii) Calculate the values of the gains in (i) above.

(4 marks)

(c) (i) Find an expression for the differential input impedance and calculate its value if $\beta = 150$.

(3 marks)

(ii) Estimate the input offset voltage, input bias current and the input offset current of the amplifier using the following data.

Tolerance of resistors $= \pm 5\%$

Tolerance of scale currents $= \pm 20\%$

Tolerance of β $= \pm 20\%$

Value of β $= 150$

Assume that the tolerances of R_1, R_5 and R_4 are negligible.

(6 marks)

QUESTION TWO *(25 marks)*

Consider the NMOS amplifier shown in Figure-Q2. Assume that the devices Q_1 and Q_2 are matched.

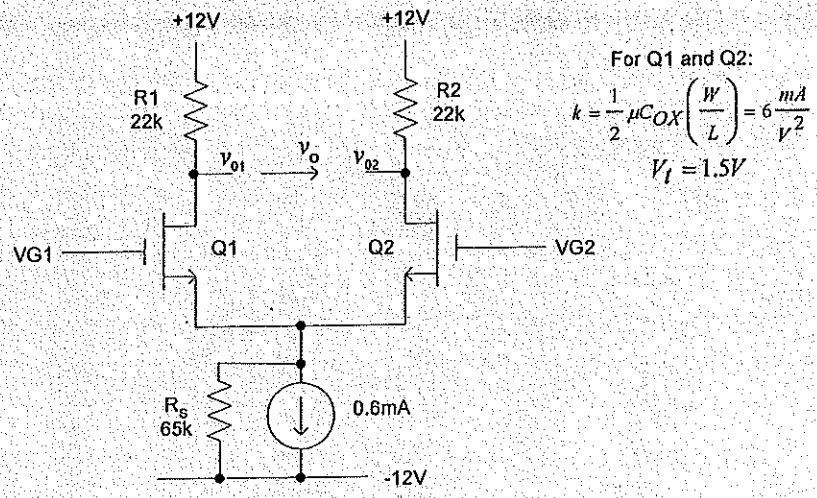

Figure - Q2

(a) If $V_{G1} = V_{G2} = 2V$, find the dc voltages at the drain and the source of the transistors.

(6 marks)

(b) If V_{G1} and V_{G2} are changed independently until $I_{D1} = 0.6mA$, calculate the value of differential input voltage applied.

(5 marks)

(c) When a common mode signal v_{cm} is applied to both inputs, find the common mode gain $\frac{v_{o1}}{v_{cm}}$ and $CMRR$. Prove any formula of the gain you use.

(6 marks)

(d) If R_1 and R_2 are having tolerances of $\pm 5\%$, find the common mode gain $\frac{v_o}{v_{cm}}$ and $CMRR$.

(8 marks)

QUESTION THREE ***(25 marks)***

(a) A current source implemented with BJTs is shown in Figure-Q3(a). The transistors are of high gain type and matched.

(i) Derive an expression for the reference current to show how it is related to Io.

(4 marks)

(ii) Show the implementation of this current source for $I_o = 125\mu A$ deriving the component values. Assume that the $V_{BE} = 0.65V$ when the collector current is $0.8mA$, for the transistors you are going to use.

(6 marks)

(iii) Calculate the output resistance R_o if $V_A = 120V$ and the $\beta = 100$.

(3 marks)

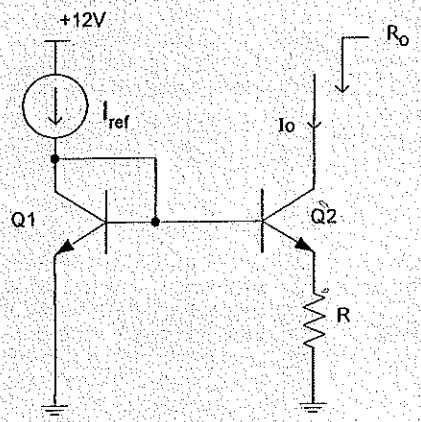

Figure-Q3 (a)

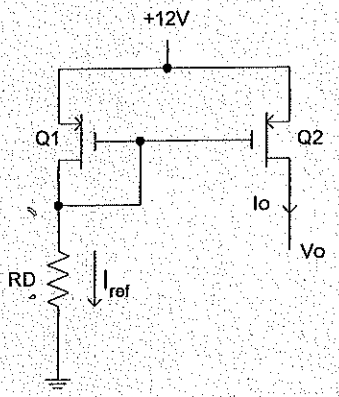

Figure-Q3 (b)

(b) A current mirror using PMOS devices is shown in Figure-Q3(b). Some of the device and circuit parameters are as follows.

$L_1 = L_2 = 6\mu m$ $W_2 = 60\mu m$ $|V_t| = 2V$ $\mu C_{OX} = 35\frac{\mu A}{V^2}$

$V_A = 75V$ $I_o = 125\mu A$ $I_{ref} = 70\mu A$

(i) Calculate the value of W_1 proving any formula you use.

(4 marks)

(ii) Find the resistance of R_D.

(3 marks)

(iii) When $V_o = 7V$, find the actual value of the output current I_o.

(5 marks)

QUESTION FOUR (*25 marks*)

A cascode amplifier is shown in Figure-Q4.

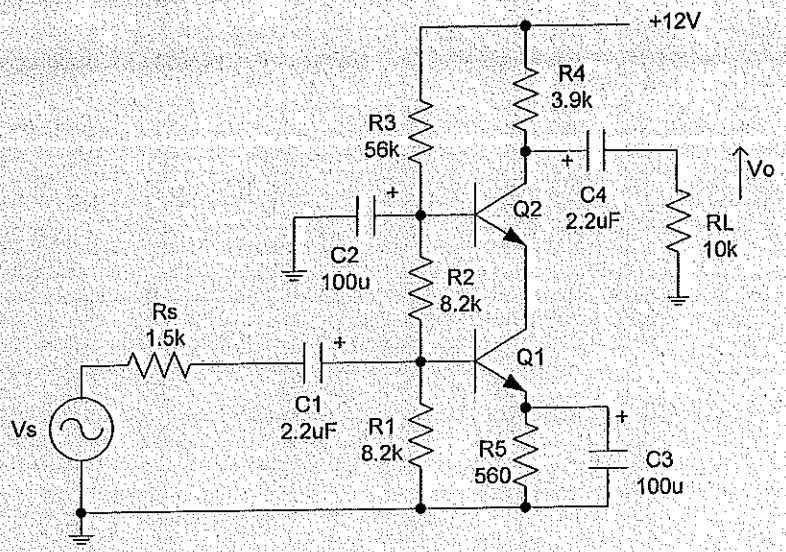

Figure-Q4

(a) Find the collector currents and collector voltages of each transistor assuming that the devices are identical and of high gain type.

(6 marks)

(b) Following parameters are given for the transistors, assuming usual notation.

$\beta = 100 \qquad C_\pi = 15pF \qquad C_\mu = 5pF \qquad r_o \gg$

(i) Derive an expression for the mid-band gain $\frac{v_o}{v_s}$ and calculate its value.

(8 marks)

(ii) Calculate the upper cut off frequency f_H using the Miller's components.

(8 marks)

(iii) What is the unity gain crossover frequency f_T of the amplifier.

(3 marks)

QUESTION FIVE (25 *marks*)

(a) Consider the circuit shown in Figure-5(a).

(i) Derive expressions for the frequency of oscillation, R_1 and R_2.

(8 marks)

(ii) Calculate all component values of the circuit for an oscillation frequency of $20kHz$. You may use capacitor values $> 0.5nF$.

(4 marks)

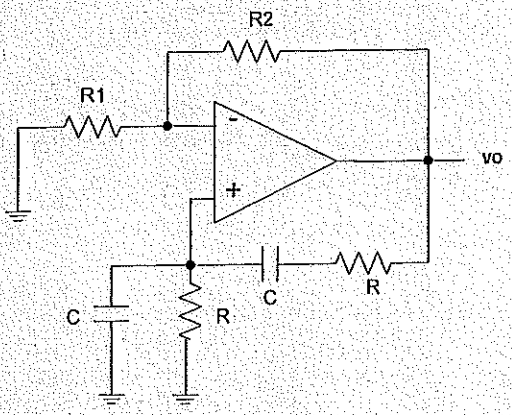

Figure -Q5(a)

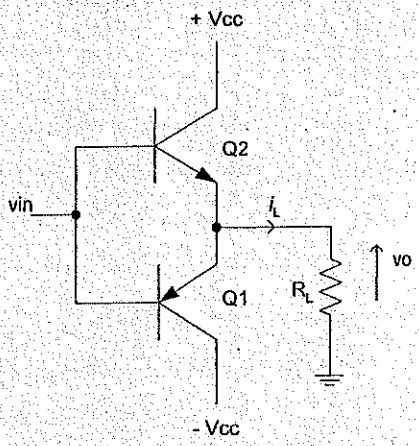

Figure - Q5(b)

(b) A power amplifier is shown in Figure-Q5(b).

(i) Derive expressions for power efficiency and power dissipated by each device.

(6 marks)

(ii) If the amplifier delivers $18W$ in to a 8Ω load, find the efficiency and power dissipation in transistors. What is the worst case power dissipation expected in a transistor? Assume $V_{cc} = 20V$.

(7 marks)

1. SOME USEFUL MOSFET EQUATIONS

$i_D = \mu_n C_{ox} \frac{W}{L}\left[(v_{GS} - v_t)v_{DS} - \frac{1}{2}v_{DS}^2\right]$ in triode region

$i_D = \frac{1}{2}\mu_n C_{ox} \frac{W}{L}(v_{GS} - v_t)^2$ in saturation region

$i_D = \frac{1}{2}\mu_n C_{ox} \frac{W}{L}(v_{GS} - v_t)^2(1 + \lambda v_{DS})$ in saturation region with Channel Modulation effect

$V_A = \frac{1}{\lambda}$

2. Unless otherwise stated $V_{BE(ON)} = 0.6V$ and $V_T = 0.025V$.

FACULTY OF SCIENCE & ENGINEERING

DEPARTMENT OF ELECTRICAL & ELECTRONIC ENGINEERING

SUPPLEMENTARY EXAMINATION

JANUARY 2020

TITLE OF PAPER: ENTREPRENEURSHIP

COURSE CODE: EE511/EEE511

TIME ALLOWED: THREE (3) HOURS

INSTRUCTIONS:

1. THIS PAPER CONSISTS OF SECTION A AND SECTION B.
2. SECTION A (CASE STUDY) IS COMPULSORY.
3. ANSWER ANY THREE QUESTIONS FROM SECTION B.

YOU ARE REMINDED THAT IN ASSESSING YOUR WORK, ACCOUNT WILL BE GIVEN OF THE ACCURACY OF LANGUAGE AND THE GENERAL QUALITY OF EXPRESSION, TOGETHER WITH THE LAYOUT AND FINAL PRESENTATION OF YOUR FINAL ANSWER.

THIS PAPER MUST NOT BE OPENED UNTIL THE INVIGILATOR HAS GRANTED PERMISSION.

SECTION A (COMPULSORY)

Question 1

Read the case and then answer the questions that follow.

Boss lady

She gets up at 4.00 in the morning to make "the rounds" on the farm before the business activities of the day begin. Her name is Dudu Dlamini, but only her mother and husband call her that. The labourers call her boss lady, the market women and everybody else calls her Sis' Dudu. She first checks the four chicken sheds which collectively stock about 25,000 broilers at a time. She ascertains the daily mortality rates which is mostly due to the extremely cold winter weather. Using diplomatic questions, she tries to find out if the labourer kept the fire going and did not fall asleep that night. Each chicken shed is assigned an employee who is not allowed to visit other sheds in the compound to prevent the spread of diseases. The previous cycle had been wiped out by the Bird Flu.

As daylight begins, she moves to the vegetable garden to give the labourers instructions on the day's activities, including what needs to be harvested and crops to be watered or weeded for the day. Water had especially become problematic as the number of households increased in the area. All households wanted running water in their houses and the current water system was simply insufficient. She goes back to the house, cleans up and readies herself for going to the market. She collects produce and leaves the house to ensure that by 6.30 a.m she is at the market place selling fresh produce to the retail market ladies and street vendors. The road is muddy and slippery after the heavy rains but she perseveres with the help of bystanders who give the bakkie the push it needs to get out of the mud.

After the market place, it is time for her to stock up on the supplies. This activity depends on the cycle of the business. When it is the beginning of the broiler cycle, it can include placing orders for the delivery of day old chick, buying and delivery of sawdust and veterinary supplies. She is lucky that the supplier of day old chicks delivers them to her farm. At the end of the cycle, it may consist of delivery of chickens to the market, which are varied and diverse, including a chicken slaughter house, butcheries and individuals. Either way, Sis Dudu is always busy. She owns and manages the whole business by herself.

She may also find herself at the bank, trying to convince the bank manager to extend her overdraft, which is always a struggle as she does not document any financial or other information about her business, claiming that she remembers all the details. The bank had also been trying to convince her to register the business as a company. She is however, wary of attracting too much attention to her business due to the new tax regime implemented by the newly established and eager Swaziland Revenue Authority, which seeks to tax agricultural businesses. Of late she has also been consulting an NGO which has convinced her to advertise her chickens in the media, and designing a logo for the business. Competition is stiff in the chicken industry and she is hoping that advertising will give her an edge over her competition.

She had been wary of the fiscal challenges faced by the Government, expecting sales of chicken to fall, but that had not yet happened. It seemed that consumers could not forego buying chicken. It was only the competition that worried her. Too many players kept the selling price too low and profit margins very narrow. Hence huge stock numbers were necessary. But selling then became a problem. She remembered the good days when the Fresh Produce Market agents used to take all the chickens and sell them in Mozambique for the farmers. She did not have to' go all over the country looking for buyers then.

Once she had completed all the business activities for the day she went back home to start cooking for her family, which should be sufficient for that days dinner and lunch the following day. Her family did not like food cooked by anybody else but herself. As soon as the vehicle approached the farm gate, labourers scattered as the security guard shouts "Boss lady"!

Questions

(a) Ms. Dlamini's business is affected by several variables from both from the internal and external environment. Identify and explain how these variables impact her business. (20 marks)

(b) How do you think she should address these variables? (10 marks)

(c) Considering the aspects or features that define an entrepreneur, does Ms. Dlamini qualify as a true, successful entrepreneur? Give reasons for your answer.
(10 Marks)

SECTION B (Answer any three questions from this section)

Question 2

Entrepreneurship is said to be rooted in creativity and innovation. It is important to dream up ideas if one aspires to be an entrepreneur. However, it is more important to translate or convert these ideas into viable business opportunities. For an idea to be an opportunity it must be attractive, it must be anchored in a good/service that adds value to its purchaser. Describe comprehensively, the process that gives one the basis whether to act on the opportunity or not. (20 marks)

Question 3

Upon completion of their studies, most students may be engaged in wage employment before starting their own businesses, if at all. As graduates of entrepreneurship studies, students are expected to exhibit an entrepreneurial spirit and behaviour even within those organizations in which they are employed. There is a difference in the culture of corporate organization that promotes entrepreneurial behaviour and one that adheres to traditional management styles. Compare and contrast the factors that distinguish one from the other. (20 marks)

Question 4

State four major sources of funds accessible to small businesses in the country. Discuss their requirements and the ability/inability of the targeted entrepreneurs to meet these requirements. (20 marks)

Question 5

New businesses have a high failure rate, which can be as high as 80% in the first year of operation. After working hard to establish a business, it is tempting to ignore imminent business bankruptcy and hope for a miracle. But there are always indications that show one that the business is about to collapse. What are these signs? How can one deal with business failure? (20 marks)