UNIVERSITY OF SWAZILAND

FACULTY OF SCIENCE

DEPARTMENT OF ELECTRONIC ENGINEERING

EXAMINATION 2006 **(SUPPLEMENTARY)**

TITLE OF PAPER: **ELECTRONICS I** Paper I

COURSE NUMBER: **E360**

TIME ALLOWED: THREE HOURS

INSTRUCTIONS: Attempt all questions

Each question carry 25 marks

Marks for different sections are shown in the right-hand margin

THIS PAPER HAS 5 PAGES, INCLUDING THIS PAGE.

DO NOT OPEN THE PAPER UNTIL PERMISSION HAS BEEN GIVEN BY THE INVIGILATOR.

Question 1

The transistor Q1 in figure 1 has the parameters g_m r_π and r_o . For the circuit shown

a) draw the equivalent circuit diagram at mid-band frequencies (5 marks)

b) determine expression for the input impedance Ri (2marks)

c) determine the expression for the output impedance Ro (2 marks)

d) determine the expression voltage gain $A = \frac{V_o}{V_s}$ (10 marks)

e) determine the expression current gain $A = \frac{I_o}{I_s}$ (6 marks)

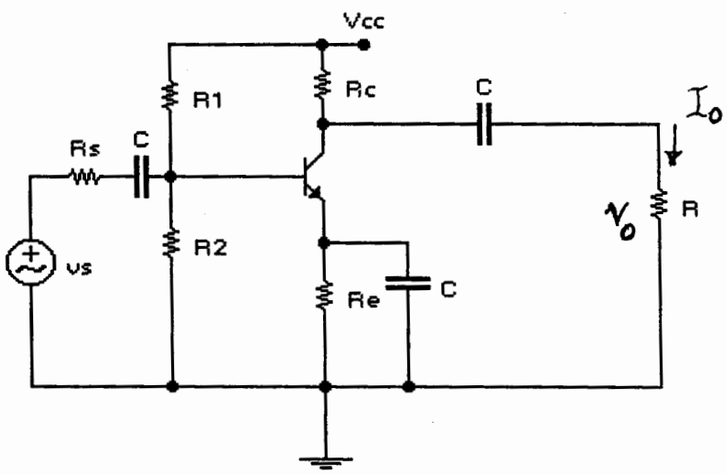

Figure 1

Question 2

a) Draw a high-frequency hybrid-π model for a BJT. Label all parameters in your drawing. (5marks)

b) Use Miller's theorem to obtain a simplified equivalent circuit of the model in part (a) of this question. Then draw the simplified circuit and label it accordingly. (7 marks)

c) For the cicuit shown in figure 2

i) obtain the gain at mid-band frequencies

ii) obtain the lower 3dB cut-off frequency in Hz (13 marks)

Note: $g_m = \frac{I_{CQ}}{V_T}$ and $\beta = g_m r_\pi = 200$, $V_{BEQ} = 0.67\,V$

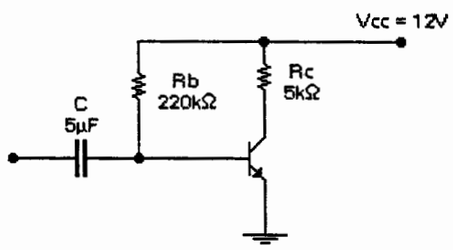

Figure 2

Question 3

For the circuit shown in figure 3, $V_i = V1-V2$, $g_m = 3mA/V$ and $r_{ds} = 20k\Omega$ obtain the following:

a) differential mode gain $A_{DM} = \frac{V_o}{V_i}$ [9 marks]

b) common mode gain $A_{CM} = \frac{V_o}{V_i}$ [14 marks]

c) common mode rejection ratio. [2 marks]

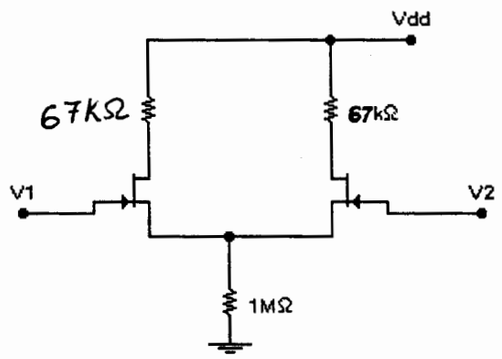

Figure 3

Question 4

a) For the peak detector power supply circuit shown in figure 4, determine the value of capacitor C and number of turns n for the transformer, so that the dc voltage across the resistor RL is less than 50V with less than 10 % peak to peak ripple when the input voltage Vi = 141sin(377t) volts.

[17 mark

b) Draw two circuit used for more efficient filtering in rectifier circuits.

[8 marks]

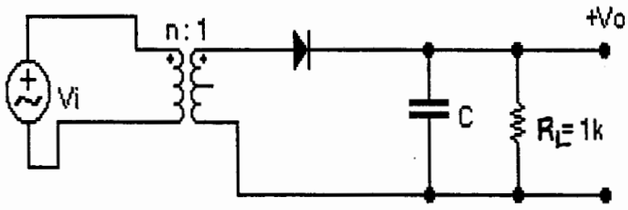

Figure 4