# UNIVERSITY OF SWAZILAND

## FACULTY OF SCIENCE

**Department of Electronic and Electrical Engineering**

# MAIN EXAMINATION 2011

Title of the Paper: **ELECTRONICS II**
Course Number: **E442**
Time Allowed: **Three Hours.**

Instructions:

1 To answer, pick any five out of seven questions in the following pages.
2. The answer is better written in the space provided in the question book. Use the answer book as a scratch pad.
3. Each question carriers 20 points.
4. This paper has 9 pages, including this page.

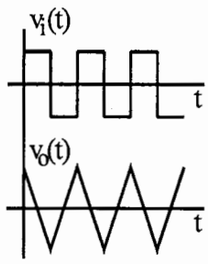
DO NOT OPEN THE PAPER
UNTIL PERMISSION HAS BEEN GIVEN BY THE INVIGILATOR.

Q1a: List special features and particular functions of the single BJT amplifier of all three configurations, CE, CB, and CC. **10 pts** (2 pts for a blank, only 5 blanks counted)

| | features | functions |
|---|---|---|
| CE | | |
| CB | | |
| CC | | |

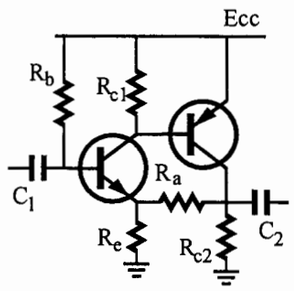
Q1b: A uA741 op amplifier output is to drive a load of 100 Ohm with the output swing ±9 volts, assuming a single power supply +24 volts. Is the op amp able to drive the load? If not, which configuration can help to do the job? Draw the schematic circuit diagram with components values. All resistors, capacitors must have reasonable values. Assume the transistor β 100. **10 pts** (5 pts for op, 5 pts for BJT)

Q2a: An op amp circuit has the input and output time trace below in the figure; draw the op amp circuit schematic diagram. **10 pts**




Q2b: Draw the circuit diagram of an op voltage follower and prove it is a voltage follower (input voltage = output voltage). **10 pts** (5 pts for circuits, 5 pts for the prove)

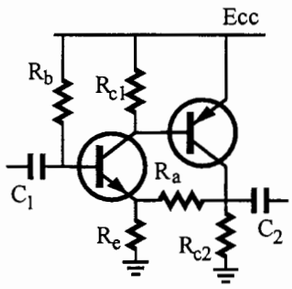
Q3a: A linear amplifier with feedback is shown below. Identify whether the feedback is positive or negative and its feedback topology. **10 pts** (4 pts for p/n, 3 for in topo, 3 for out topo)




Q3b: Calculate the voltage amplification factors both with and without feedback. Given signal source: $R_s$=0; Circuit components in Ohm: $R_{C1}$= 8K, $R_{C2}$=2K, $R_e$=0.2K, $R_a$=8K. Be aware that the second transistor is pnp but complimentary to the first; ie, the two are identical in their parameters, $r_\pi$=2K Ohm, $\beta$=120. Needs symbolic network equations first before numerical solving calculation. **10 pts** (5 pts for with, 5 pts for without)

## Without Feedback:

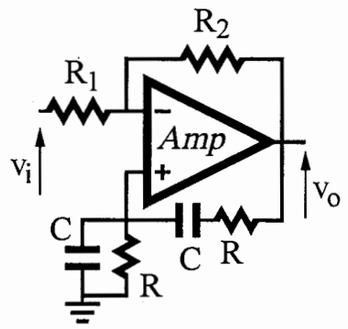
## With Feedback:



Q4a: Draw any signal generating schematic circuit covered in our discussions, except already shown in this paper. It must have components values, which must be reasonably enough to suppose the circuit working fine. 10 pts (5 for circuit, 5 for component values)

Q4b: Pick any one ADC and any one DAC, and describe them with symbolic diagrams/circuits and equations. **10 pts** (5 pts for ADC, 5 pts for DAC)

Q5a: A Wien BPF amplifier is shown below; derive the voltage amplification factor in terms of the component symbols given. $R_s$=0. **10 pts**

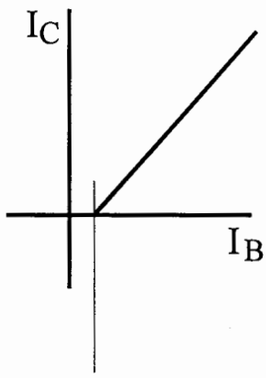


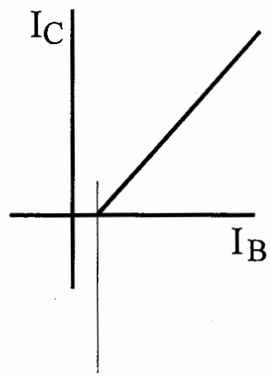

Q5b: Discuss the stability of the amplifier in terms of the resistor ratio, $R_2/R_1 \equiv \eta$; that is, to discuss circuit states in every possible domain $(\eta_i, \eta_{i+1})$ in $[0,\infty)$. **10 pts**

Q6a: 2N3055 has a power dissipation rating 125 Watts at case temperature 25°C and a maximum junction temperature 200°C. To maintain a case temperature 25°C needs an infinitively large heat sink, which is not possible. Design a practical heat sink to dissipate the heat to the air at a temperature 25°C. Assume the transistor case and heat sink has a perfect thermal contact. Study the relationship between the power dissipation rating, $P_D$, and case temperature, $T_C$. Draw the curve $P_D$~$T_C$. Case temp may be around 45°C; calculate sink $\theta_{ca}$ , where ca is between the case and the air. **10 pts** (5 pts for curve, 5 pts for sink $\theta_{ca}$)

Q6b: Draw a switching topology to step-up a DC battery voltage 12 V to a higher DC voltage 24 V. Implement this circuit. **10pts** (5 for topo, 5 pts for implement)

Q7a: Use $I_B$~$I_C$ curve to define amplifier class: A, AB, B, and C. Important: Mark the ac zero-crossing points clearly on the signal. Which one is a linear amplifier? **10 pts** (2 pts for each answer)(10 pts for bonus)




Q7b: Drive the efficiency of a class B amplifier. The transistors are idealized. **10 pts**