INDUSTRIAL ELECTRONICS MECH 372/2 Section X

Mid-Term #2 Tuesday November 21, 2000

Answer All 3 Questions

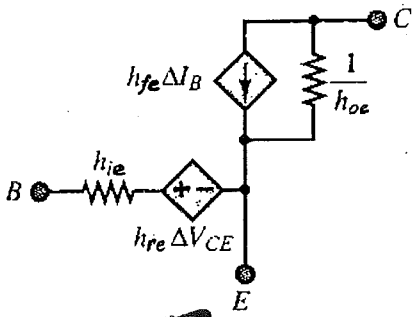
Question #1 (a=4, b=1, c=1, d=1, e=2, f=1, g=2, h=2 →→→→ 14 marks)

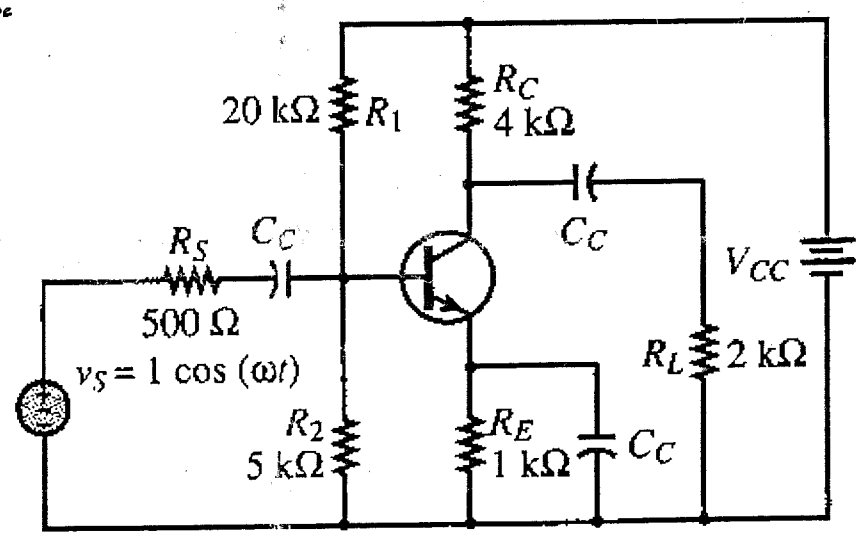
Note: ***If formulas are ONLY stated, no marks will be given.***
All formulas MUST be derived from circuit analysis. Show all steps in your analysis.

For the circuit shown below, the following h parameters are given:
$h_{ie} = 1.4\ \text{k}\Omega$, $h_{fe} = 100$, $h_{oe} = 125\ \mu\text{S}$, h_{re} = neglect

a) • Simplify the circuit below and draw the circuit for DC-analysis.
   • Find the quiescent point of the transistor given that $V_{CC} = 20$ V and $\beta = h_{fe} = 100$.
   • Assume that the transistor has a diode cut-in voltage $V_\gamma = 0.6$ V .
b) Draw the AC equivalent circuit, using h parameters.
c) Derive the expression for the input resistance R_{in} and calculate the numerical value.
d) Derive the expression for the output resistance R_o as seen by the load R_L, and calculate the numerical value. **Do not neglect h_{oe} .**
e) Derive the open circuit voltage gain μ and calculate the numerical value. **Do not neglect h_{oe} .**
f) Using the results from parts (c), (d) and (e), draw the equivalent circuit model of the voltage amplifier.
g) Derive the actual voltage gain $A_V = v_L/v_S$ and calculate the numerical value.
h) Derive the current gain $A_I = I_L/I_S$ and calculate the numerical value.

Information: The h-parameter small-signal model for BJT is given as:





Question #2 (8 marks)

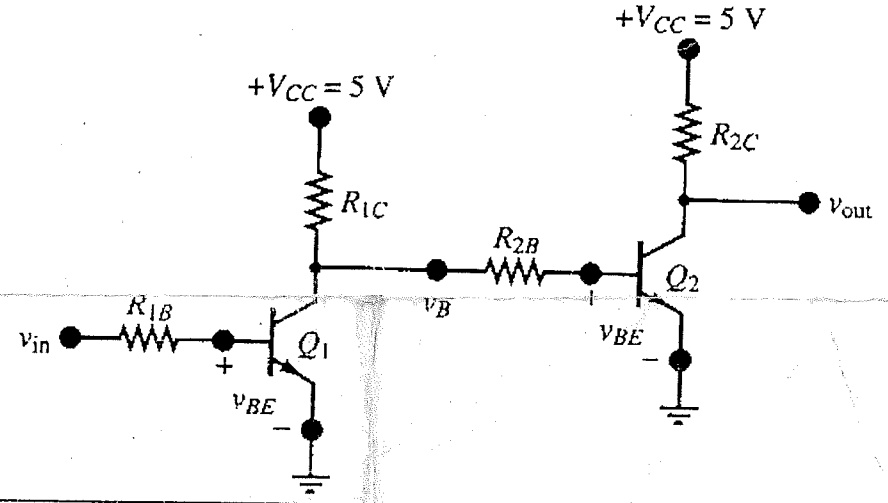
The figure below shows two transistors operating as a switch, which are connected as two inverters in series, where:

$R_{1C} = R_{2C} = 10\ k\Omega$ and $R_{1B} = R_{2B} = 27\ k\Omega$

a) Find v_B , v_{out} and the (***clearly explain***) state of transistor Q_1 when v_{in} is low.
b) Find v_B , v_{out} and the (***clearly explain***) state of transistor Q_1 when v_{in} is high.

NOTE:

- All assumptions must be stated clearly and with supporting proof.
- Show all relevant equations.
- No marks will be given for numbers simply stated without supporting assumptions or calculations.



Question #3 (8 marks)

Derive the transfer function for the circuit given below.
You must provide mathematical steps and explain any assumptions taken.