# INTERNATIONAL ISLAMIC UNIVERSITY MALAYSIA
## END OF SEMESTER EXAMINATION
## SEMESTER II, 2012/2013 SESSION
## KULLIYYAH OF ENGINEERING

Programme : ENGINEERING
Level of Study : UG 2

Time : 2:30 pm-5:30 pm
Date : 26/05/2013
Duration : 3 Hrs

Course Code : ECE 2133
Section(s) : 1-2

Course Title : **Electronic Circuits**

This Question Paper consists of **Six (6)** Printed Pages (Including cover and a blank page) with **Five (5)** Questions.

***INSTRUCTION(S) TO CANDIDATES***

DO NOT OPEN UNTIL YOU ARE ASKED TO DO SO

- A total mark of this examination is **100**.
- This examination is worth **50%** of the total assessment.
- Answer **ALL FIVE (5)** questions.
- Useful formula and necessary parameters are given in page 6.

**Any form of cheating or attempt to cheat is a serious offence which may lead to dismissal.**

**Q.1 [20 marks]**

**(a)** The MOSFET circuit is shown in **Fig. 1**, the transistor parameters are $K_n$ = 0.5 mA/V$^2$, $V_{TN}$ = 0.8V and λ = 0. Find $V_{GS}$, $I_D$, and $V_{DS}$. Also calculate the small-signal hybrid-π parameters $g_m$ and $r_o$. **(10 marks)**

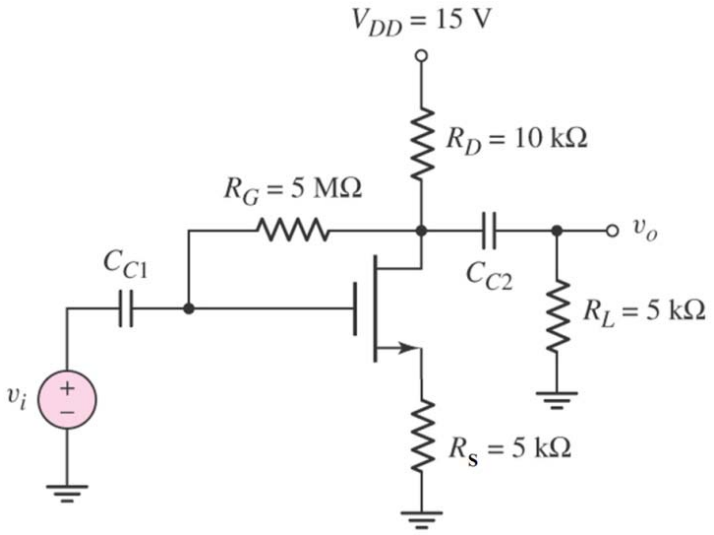


**Fig. 1(a)**

**(b)** The BJT amplifier circuit is shown in **Fig. 1(b),** the transistor parameters are β=100 and $V_A$=100. (**i**) Determine $I_{CQ}$ and $V_{CEQ}$ (**ii**) find the small-signal hybrid-π parameters $r_\pi$, $g_m$ and $r_o$. **(10 marks)**

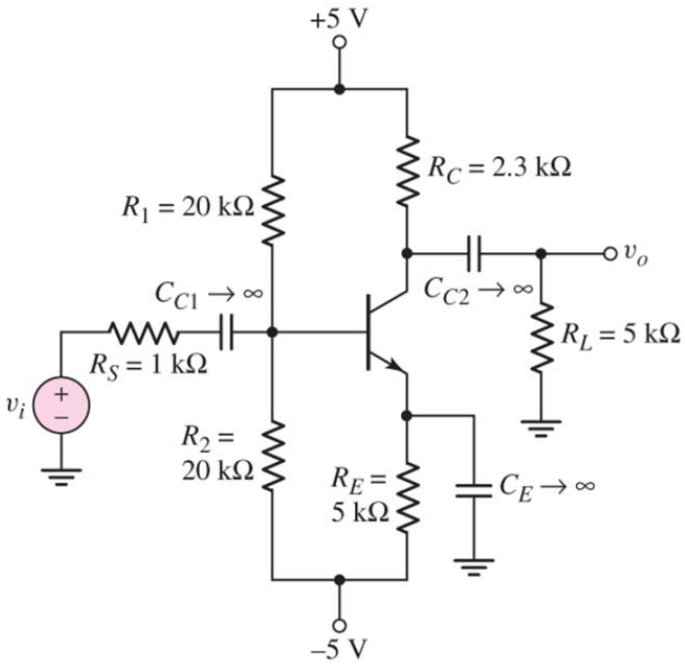


**Fig. 1(b)**

**Q.2 [20 marks]**

Draw the small signal equivalent circuit diagram of the MOSFET amplifier which is shown in **Fig. 2** and find followings; **(20 marks)**

**(i)** the input resistance $R_i$,

**(ii)** the voltage gain $A_v = \frac{v_o}{v_s}$ and

**(iii)** the output resistance $R_o$ of the amplifier at midband frequencies . The transistor parameters are $g_m$=0.65 mA/V and $r_o$ = 100 kΩ.

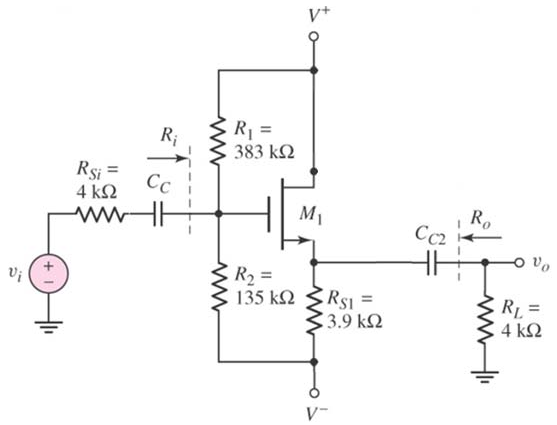


**Fig. 2**

**Q.3 [20 marks]**

**(a)** Draw the Bode plot (magnitude and phase) of the following transfer function.

$$H(s) = \frac{10^6 s(s+10)}{(s+100)(s+1000)}$$ **(8 marks)**

**(b)** The common emitter transistor amplifier is shown in **Fig. 3(b)** and the transistor has small signal hybrid-π parameters, $r_\pi$ = 2.5 kΩ, $g_m$= 40mA/V and $r_o$ =∞.

**(i)** Determine the value of $C_C$ such that the lower 3dB/corner frequency is 15Hz.

**(ii)** Find the maximum current gain $|A_i|_{dB}$ in dB, where $A_i = \frac{i_o}{i_s}$. **(12 marks)**

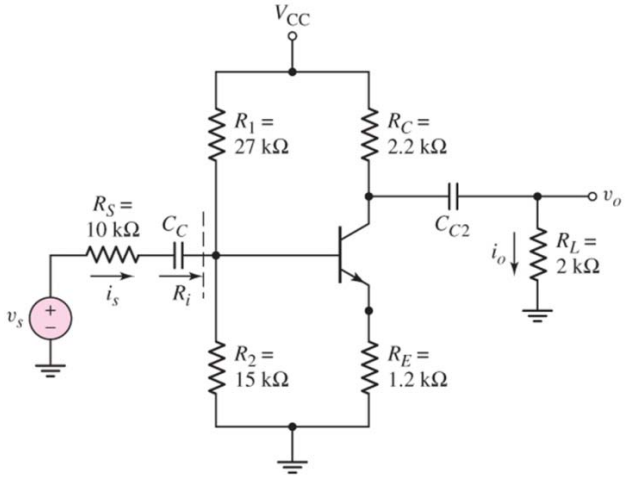


**Fig. 3(b)**

**Q.4 [20 marks]**

**(a)** A BJT is biased at $I_C$ = 0.15 mA, and has parameters $\beta_o$ = 150, $C_\pi$ = 0.8pF and $C_\mu$ = 0.12pF. Determine beta cutoff frequency $f_\beta$ and cutoff frequency $f_T$. **(5 marks)**

**(b)** The common emitter amplifier is shown in **Fig. 4(b)** which is operated at high frequencies. The transistor parameters are: $r_\pi$ = 3 kΩ, $g_m$= 40 mA/V and $r_o$ = ∞, $C_\pi$ = 25 pF, and $C_\mu$= 2 pF. **(15 marks)**

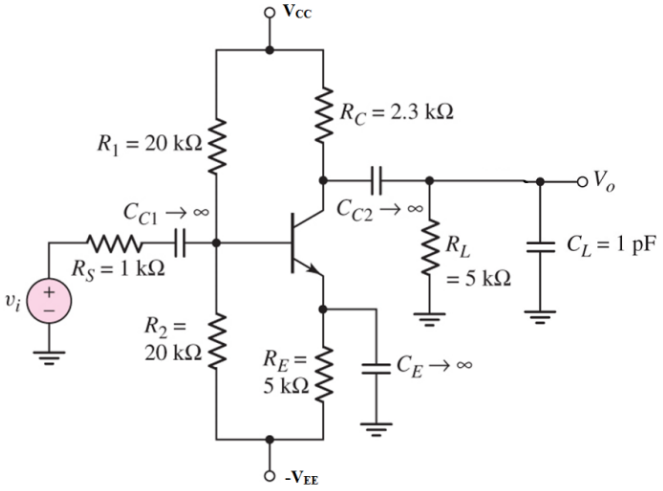


**Fig. 4(b)**

(i) Draw the high-frequency equivalent circuit diagram.
(ii) Draw the Miller equivalent circuit diagram.
(iii) Find the Miller capacitance.
(iv) Find the upper 3 dB/corner frequency ( $f_H$ ) without Miller capacitance,
(v) Find the upper 3 dB/corner frequency ( $f_H$ ) with Miller capacitance,
(vi) Find the upper 3 dB/corner frequency ( $f_H$ ) with load capacitance, $C_L$ and
(vii) Find the midband voltage gain.

**Q.5 [20 marks]**

**(a)** State 5 advantages and 2 disadvantages of a negative feedback amplifier. **(5 marks)**

**(b)** The open-loop low-frequency voltage gain of an amplifier is $A_v = 5 \times 10^4$ and the open-loop 3 dB frequency is $f_H$ = 10Hz. If the closed-loop gain is $A_{vf}$ = 25, what is the closed- loop bandwidth? **(5 marks)**

**(c)** A series-series feedback amplifier topology is shown **Fig. 5(c)**. Draw the ideal equivalent circuit diagram and find the closed loop transconductance gain, $A_{gf}$, the input resistance, $R_{if}$ and output resistance $R_{of}$.

**(10 marks)**

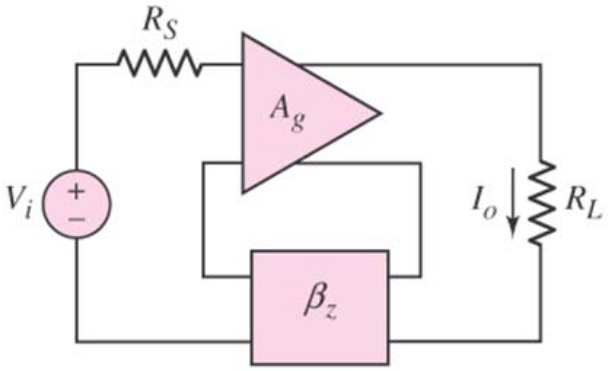


**Fig. 5(c)**

**USEFUL FORMULA**

| BJT | MOSFET |
|---|---|
| $i_C = I_S e^{v_{BE}/V_T} \cdot \left(1 + \frac{v_{CE}}{V_A}\right)$<br>$g_m = \frac{I_{CQ}}{V_T}$<br>$r_\pi = \frac{\beta V_T}{I_{CQ}}$<br>$r_o = \frac{V_A}{I_{CQ}}$<br>$V_T = 26\,\text{mV}$<br>$V_{BE}(on) = 0.7\text{V}$ | $g_m = 2\sqrt{K_n I_{DQ}}$<br>$r_o = \frac{1}{\lambda I_{DQ}}$<br>$K_n = \frac{k_n'}{2}\left(\frac{W}{L}\right)$ |