INTERNATIONAL ISLAMIC UNIVERSITY MALAYSIA

KULLIYYAH OF ENGINEERING

END OF SEMESTER EXAMINATION
SEMESTER I, 20172018 SESSION

Programme	: **Engineering**	Level of Study	: **UG 2**
Time	: **9:00 am -12:00 pm**	Date	: **02/01/2018**
Duration	: **3 Hrs**		
Course Code	: **EECE 2313/ECE 2133**	Section(s)	: **1-3**
Course Title	: **Electronic Circuits**		

This Question Paper Consists of **6 (Six)** Printed Pages (Including Cover Page) with **5 (Five)** Questions.

INSTRUCTION(S) TO CANDIDATES

DO NOT OPEN UNTIL YOU ARE ASKED TO DO SO

- Total mark of this examination is **100.**
- This examination is worth **50 %** of the total course assessment.
- Answer **ALL QUESTIONS.**
- Only approved calculator with 'KoE approved' sticker is allowed (non-programmable and non-graphical).
- Marks assigned to each problem are listed in the margins.

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

All electronics gadgets are prohibited in the exam hall / venue.
(e.g. mobile / smart phones, smart watches, and smart glasses)

Q.1 [20 marks]

(a) Consider the circuit shown in **Fig. 1(a)**, derive the expression (step by step) for the voltage transfer function, $T(s) = {v_o(s)}/{v_i(s)}$. Find the corner frequency of the circuit if C_{P1} = 30 pF, C_{P2} = 60 pF, R_S = 30 kΩ and R_P = 60 kΩ. (8 marks)

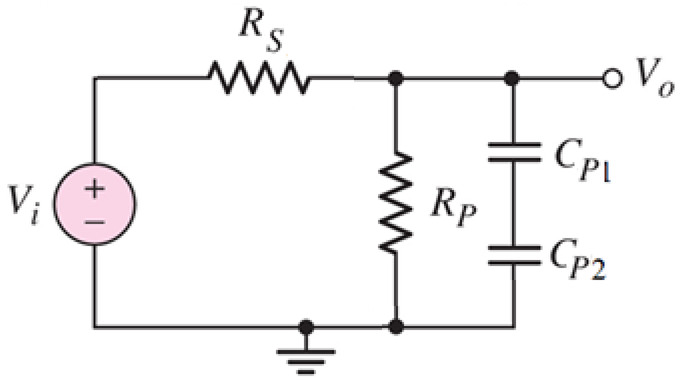


Fig. 1(a)

(b) Draw the Bode plot (magnitude and phase) of the following transfer function. (8 marks)

$$T(s) = 10^6 \frac{s(s+50)}{(s+500)(s+100)}$$

(c) Determine the magnitude and phase of the transfer function from the plots drawn for **Q1(b)** at frequency ω = 300 radian/sec. (4 marks)

Q.2 [20 marks]

(a) The common emitter amplifier as shown in **Fig. 2(a)** with the following circuit component values, R_s = 0.5kΩ, R_1 = 234 kΩ, R_2 = 166 kΩ, R_E = 1 kΩ, R_C = 5 kΩ, R_L = 20 kΩ. The BJT has small-signal hybrid-π parameters, g_m = 40 mA/V, r_π = 3 kΩ and $r_o = \infty$.

Design the amplifier circuit that operates at lower corner frequency, f_L = 300 Hz and the bandwidth of the amplifier, BW = 500 kHz. Determine the maximum gain of the designed amplifier in dB. (10 Marks)

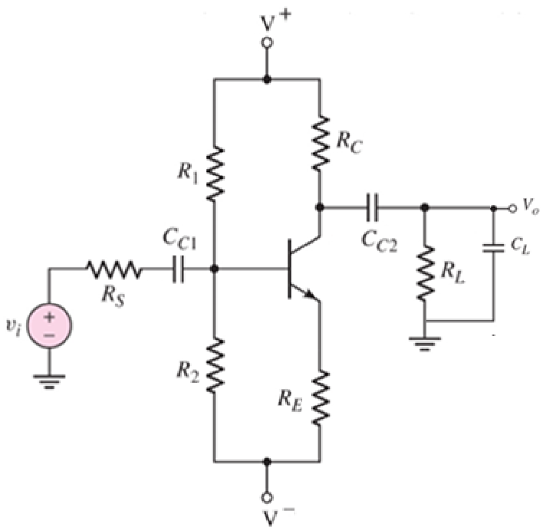


Fig. 2(a)

(b) Draw the simplified small-signal high-frequency equivalent circuit of **Fig. 2(b)**. (2 marks)

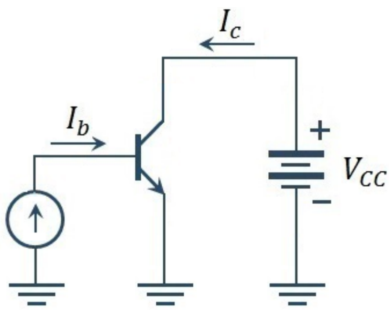


Fig. 2(b)

(c) Determine the transistor short-circuit beta frequency, f_β and cutoff frequency, f_T using the simplified small-signal high-frequency equivalent circuit of **Fig. 2(b)**. (8 marks)

Q.3 [20 marks]

(a) The three transistor current source as shown in **Fig. 3(a)** has a finite β and infinite early voltage V_A. Derive step by step the expression for I_O in terms of I_{REF} and β. (10 marks)

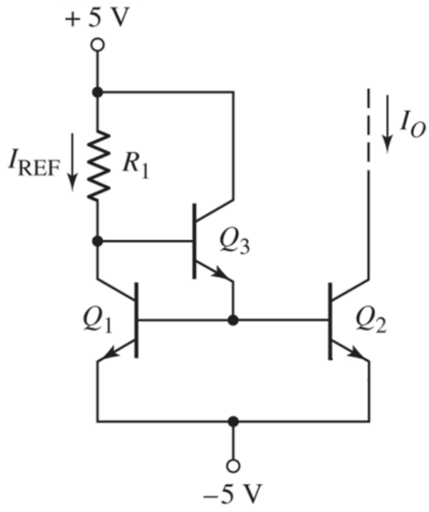


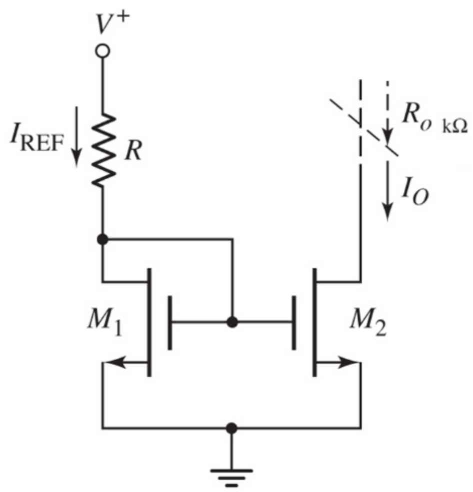
Fig. 3(a)

(b) Design a three transistor current source as shown in **Fig. 3(a)** such that I_O **= 5** mA. What is the value of I_{REF}? The transistor parameters are: V_{BE}(on) = 0.7 V, β = 100 and $V_A = \infty$.

(4 marks)

(c) Draw the small signal equivalent circuit diagram of the current source shown in **Fig. 3(a).** (2 marks)

(d) Design a MOSFET current source as shown in **Fig. 3(b)** such that I_{REF} = 20 mA, I_o = 50 mA, and $V_{DS2(sat)}$ = 0.2 V. The biasing voltage, V^+ = 12 V. The transistors are available with parameters: $k_n' = 50 \mu A / V^2$, V_{TN} = 0.4 V and λ = 0. (4 marks)



(a) Fig. 3(b)

Q.4 [20 marks]

(a) What are the merits and demerits of the negative feedback amplifier? (3 marks)

(b) Prove that gain sensitivity of an amplifier is improved with negative feedback. (4 marks)

(c) The open loop gain of a voltage amplifier is changed from 1000 to 850 due to temperature effects. Design a negative feedback system to improve the gain stability 1.5% by determining the feedback factor β. (3 marks)

(d) Draw the block diagram and small signal equivalent circuit diagram of a shunt-shunt ideal feedback amplifier. Analyze step by step the feedback amplifier to find the expression of the closed loop gain, A_f, the input resistance, R_{if} and the output resistance, R_{of} in terms of open-loop amplifier gain, A and feedback amplifier gain, β. (10 marks)

Q.5 [20 marks]

(a) What are the conditions for oscillation? (2 marks)

(b) A wine bridge oscillator circuit is shown in **Fig. 5.** Derive the transfer function of the feedback network and derive the frequency of oscillation, f_o. Find the minimum amplifier gain for sustained oscillations. (12 marks)

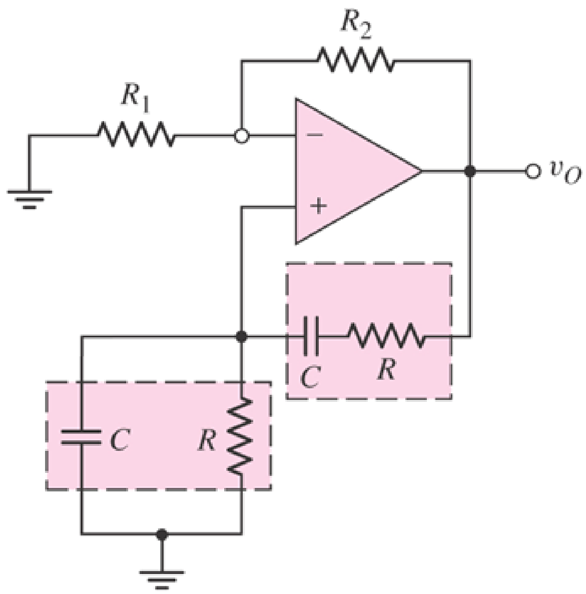


Fig. 5

(c) Design a wine bridge oscillator for generating 20 kHz. Assume that the capacitor value is 0.8nF. (4 marks)

USEFUL FORMULA

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

END OF PAPER