INTERNATIONAL ISLAMIC UNIVERSITY MALAYSIA

KULLIYYAH OF ENGINEERING

END OF SEMESTER EXAMINATION
SEMESTER 1, 2018/2019 SESSION

Programme	: **Engineering**	Level of Study	: **UG 2**
Time	: **2:30 pm -5:30 pm**	Date	: **31/12/2018**
Duration	: **3 Hrs**		
Course Code	: **EECE 2313/ECE 2133**	Section(s)	: **1-2**
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 R = 3 kΩ R_1 = 6 kΩ, C_1 = 0.05 μF and R_2 = 8 kΩ. **(8 marks)**

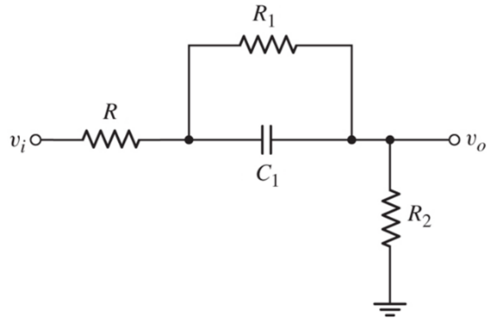

Fig. 1(a)

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

$$T(s) = 10^7 \frac{(s+1)(s+100)}{(s+1000)}$$

(c) Determine the magnitude and phase of the transfer function from the plots drawn for **Q1(b)** at frequency $\omega = 700$ radian/sec. **(4 marks)**

Q.2 [20 marks]

(a) The common emitter amplifier is shown in **Fig. 2(a)** with the following circuit component values, R_s = 0.5 kΩ, R_B = 60 kΩ, R_E = 3 kΩ, R_L = 10 kΩ. The BJT has small-signal hybrid-π parameters, g_m = 40 mA/V, r_π = 3 kΩ and r_o = 100 kΩ.

Design the amplifier circuit that operates at lower corner frequency, f_L = 60 Hz and the bandwidth of the amplifier, BW = 40 kHz. Determine the midband volatage and current gain of the designed amplifier in dB. **(14 Marks)**

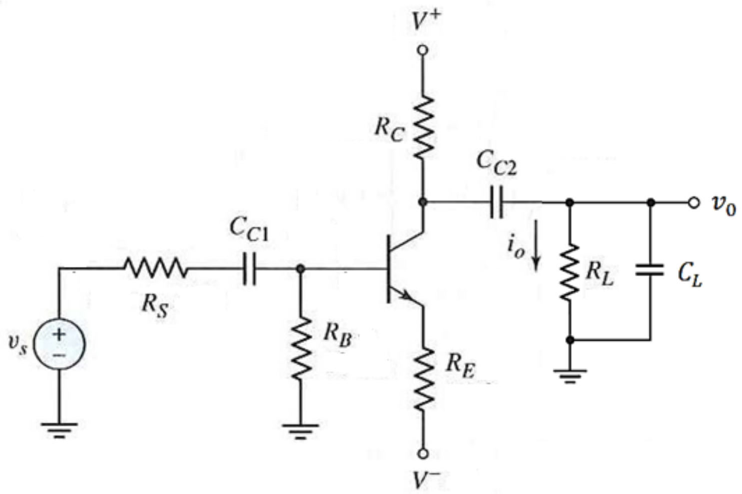

Fig. 2(a)

(b) Draw a small signal high frequency equivalent circuit diagram of a short circuited BJT amplifier as shown in **Fig. 3(a)**. Analyze the circuit step by step to find the short circuit current gain, $A_i = \frac{i_o}{i_i}$. Evaluate the unity gain bandwith, f_T of the BJT if the transistor parameters are given as g_m = 2 mA/V, C_{gd} = 10fF and C_{gs} = 50 fF. (10 marks

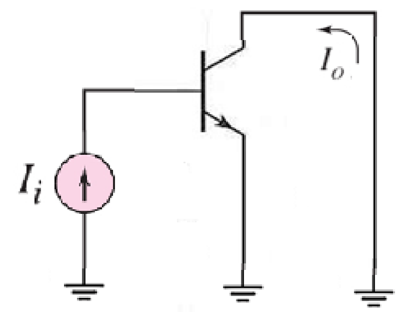

Fig. 2(b)

Q.3 [20 marks]

(a) Derive step by step the relation between I_{REF} and I_o *a* three-transistor current source as shown in **Fig. 3(a)** and design the current source such that I_O = 5 mA. The transistor parameters are: V_{BE} (on) = 0.7 V, β = 100 and $V_A = \infty$. **(10 marks)**

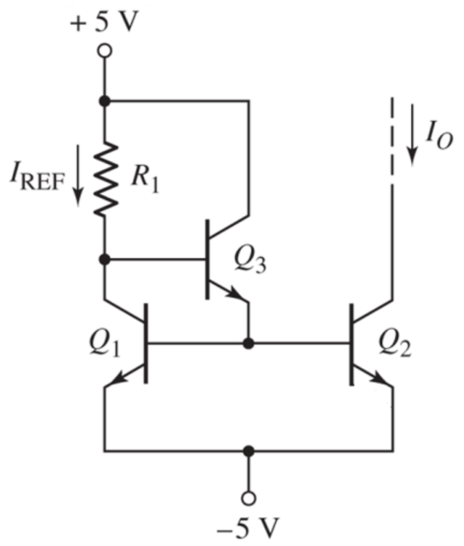

Fig. 3(a)

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

(c) Design a MOSFET current source as shown in **Fig. 3(c)** such that I_{REF} = 0.1mA, I_{o1}= 0.2 mA, I_{o2}= 0.3 mA assuming M_3, M_4 and M_5 are identical. The transistors are available with parameters $k_n' = 80\ \mu A/V^2$, V_{TN} = 0.7 V and $\lambda = 0$. **(8 marks)**

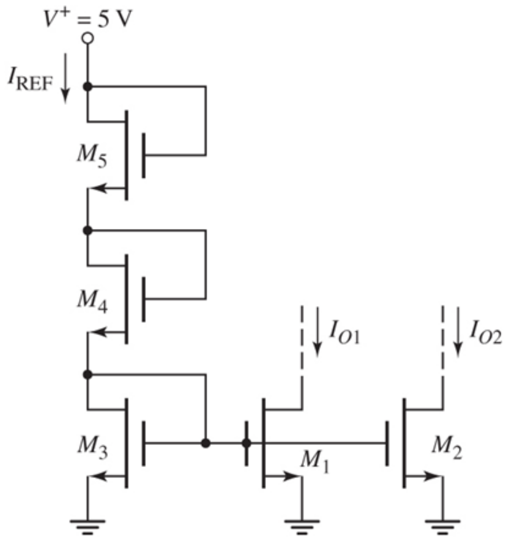

Fig. 3(c)

Q.4 [20 marks]

(a) Draw a basic configuration of a feedback amplifier and show step by step that the gain sensitivity is reduced by a factor of $(1+\beta A)$. **(5 marks)**

(b) 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)**

(c) For a series shunt feedback system, the open-loop gain A_v and closed loop gain A_{vf} of the amplifier are 10^5 and 60 respectively. Find the input resistance and output resistance of the amplifier if the input and output resistances of the basic amplifier are R_i = 15 kΩ and R_o = 35 kΩ respectively. Also find the closed loop bandwidth if the open loop amplifier bandwidth is 10 kHz. **(5 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**)

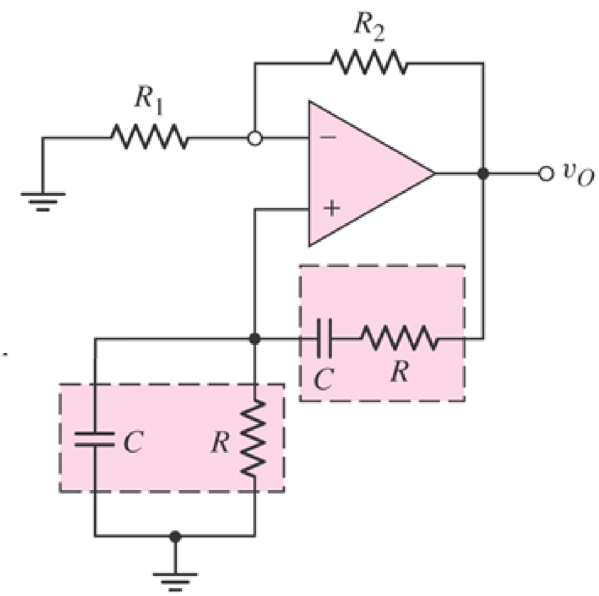

Fig. 5

(c) Design a wine bridge oscillator for generating 10 kHz. (**4 marks**)

USEFUL FORMULA

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

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