KULLIYYAH OF ENGINEERING

END OF SEMESTER EXAMINATION
SEMESTER 2, 20172018 SESSION

Programme	: **Engineering**	Level of Study	: **UG 2**
Time	: **9:00 am -12:00 pm**	Date	: **01/06/2018**
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_S = 2 kΩ, Cs = 0.5 μF and R_P = 10 kΩ. **(8 marks)**

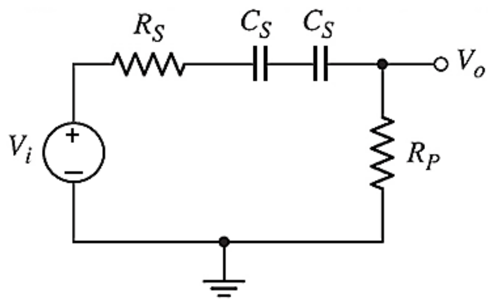

Fig. 1(a)

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

$$T(s) = 10^5 \frac{s(s+100)}{(s+50)(s+1000)}$$

(c) Determine the magnitude and phase of the transfer function from the plots drawn for **Q1(b)** at frequency ω = 500 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_1 = 100 kΩ, R_2 = 33 kΩ, R_E = 1 kΩ, R_L = 10 kΩ. The BJT has small-signal hybrid-π parameters, g_m = 40 mA/V, r_π = 3 kΩ and $r_o = \infty$.

Design the amplifier circuit that operates at lower corner frequency, f_L = 20 Hz and the bandwidth of the amplifier, BW = 25 kHz. Determine the midband current gain of the designed amplifier in dB. **(14 Marks)**

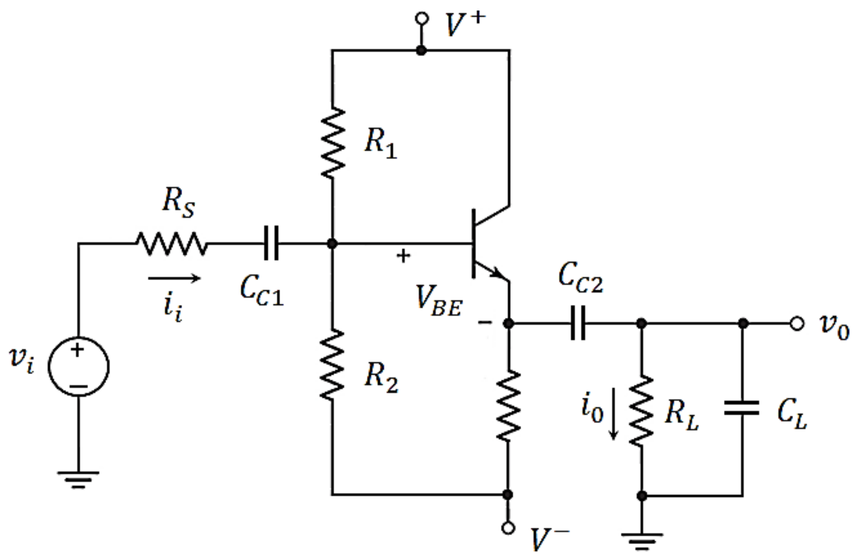

Fig. 2(a)

(b) A common source amplifier is shown in **Fig. 2(b)** that operates at very high frequencies. The coupling and bypass capacitors have very large values. The transistor parameters are: $g_m = 2$ mA/V, $r_o = 100$ kΩ, $C_{gs} = 50$ fF and $C_{gd} = 8$ fF.

(i) Draw the simplified high-frequency small signal equivalent circuit diagram and Miller equivalent circuit diagram. **(3 marks)**

(ii) Evaluate the upper 3dB frequency, f_H with and without considering Miller capacitance. **(3 marks)**

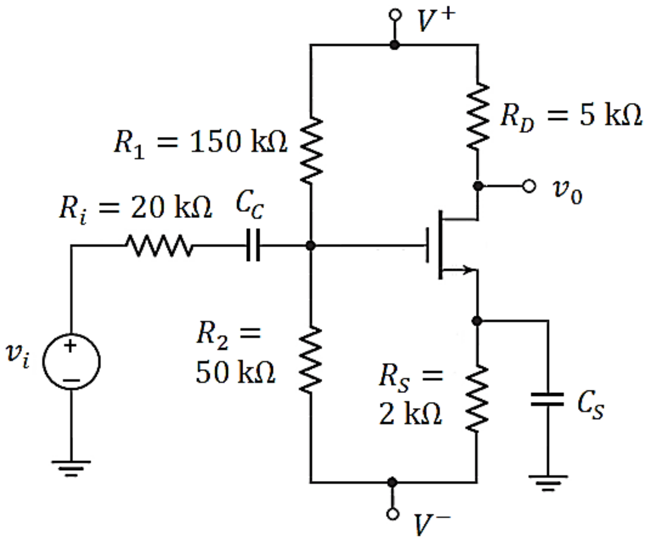

Fig. 2(b)

Q.3 [20 marks]

(a) The circuit diagram of a Wildar current source is shown in **Fig. 3(a)**. Design the circuit such that $I_{REF} = 0.5$ mA and $I_O = 50\mu$A neglecting the base currents. Also determine V_{BE2}.
[Given that $V^+ = 5$ V, $V^- = -5$ V and $V_A = \infty$] **(10 marks)**

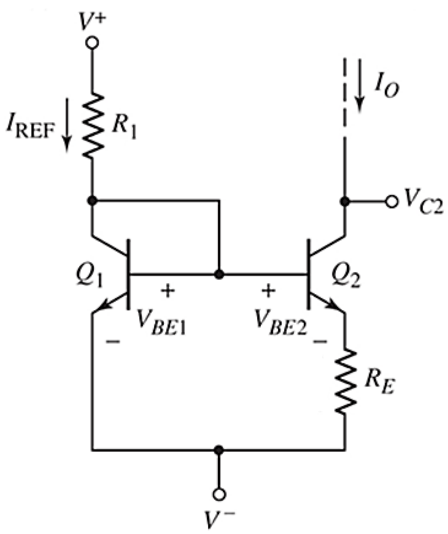

Fig. 3(a)

(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} = 0.5mA, I_{o1}= 1 mA, I_{o2}= 20 mA and V_{Dsat3} = 0.6 V. The bias voltage V^+ = +5 V and V^- = -5 V. The transistors are available with parameters $k_n' = 40\ \mu A/V^2$, V_{TN} = 1 V and λ = 0. **(8 marks)**

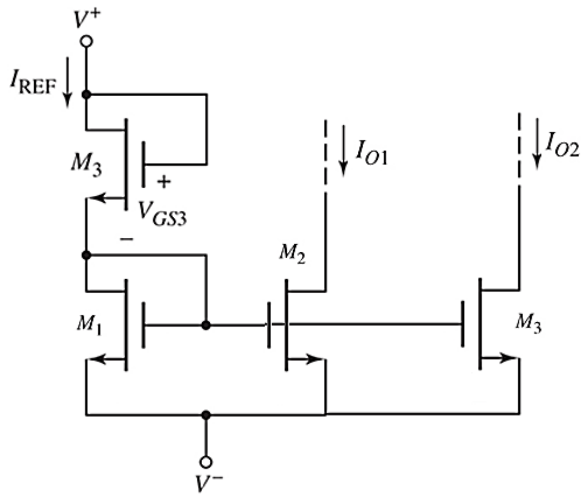

Fig. 3(c)

Q.4 [20 marks]

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

(b) Draw the block diagram and small signal equivalent circuit diagram of a Series-Series 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 shunt series feedback system, the open-loop gain A_i and closed loop gain A_{if} 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 1 kHz. **(5 marks)**

Q.5 [20 marks]

(a) A phase-shift RC oscillator is shown in **Fig. 5(a)**. Derive the transfer function of the feedback network, $\beta(s) = \dfrac{v_f(s)}{v_o(s)}$ by neglecting the loading effect of the *C*-*R* stage. Derive the frequency of oscillation, f_o. Also find the minimum amplifier gain for sustained oscillations. **(16 Marks)**

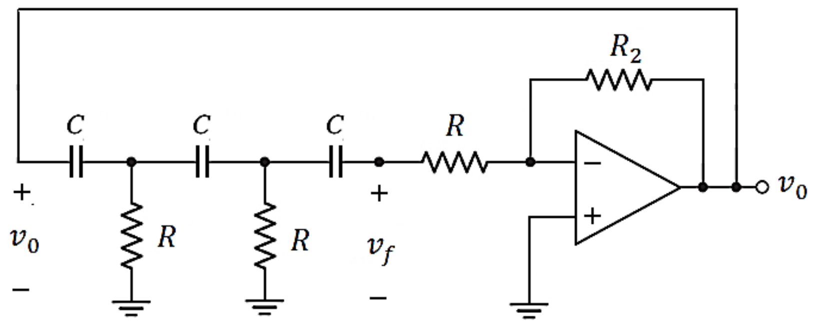

Fig. 5(a)

(b) Design the phase shift oscillator as shown in **Fig. 5(a)** which oscillation frequency is f_o = 10 kHz. **(4 Marks)**

USEFUL FORMULA

BJT	MOSFET
$i_C = I_S e^{v_{BE}/V_T} \cdot \left(1 + \frac{v_{CE}}{V_A}\right)$ $g_m = \frac{I_{CQ}}{V_T}$ $r_\pi = \frac{\beta V_T}{I_{CQ}}$ $r_o = \frac{V_A}{I_{CQ}}$ $V_\mathrm{T} = 26\,\mathrm{mV}$ $\mathrm{V_{BE}}(on) = 0.7\mathrm{V}$	$I_D = \frac{1}{2} k_n^{'} \left(W/L\right)(V_{GS} - V_T)^2 (1 + \lambda V_{DS})$ $g_m = 2\sqrt{K_n I_{DQ}}$ $r_o = \frac{1}{\lambda I_{DQ}}$

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