الجامعة الإسلامية العالمية ماليزيا
INTERNATIONAL ISLAMIC UNIVERSITY MALAYSIA
يونيبرسيتي إسلام انتارابغسا ملسيا

KULLIYYAH OF ENGINEERING

END OF SEMESTER EXAMINATION
SEMESTER II, 2019/2020 SESSION

Programme	: **Engineering**	Level of Study	: **UG 2**
Time	: **9:00 am - 12:00 pm**	Date	: **06/08/2019**
Duration	: **3 Hrs**		
Course Code	: **EECE 2313**	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 **80.**
- This examination is worth **60 %** 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) of the voltage transfer function $T(s) = \frac{v_o(s)}{v_i(s)}$ and find the time constants and the corner frequencies. **(10 marks)**

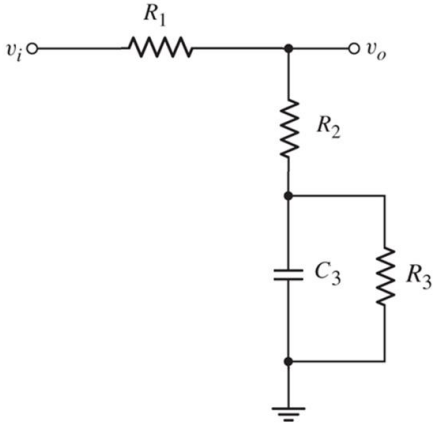

Fig. 1(a)

(b) Draw the Bode plots (**magnitude and phase**) of the following transfer function. **(10 marks)**

$$T(s) = \frac{10^6(100+s)}{s(s+1000)(s+500)}$$

and find the magnitude in dB and phase angle at angular frequency ω = 300 rad/s and ω = 800 rad/s.

Q.2 [20 marks]

(a) Design a voltage amplifier as shown in **Fig. 2** such that the magnitude of the voltage gain, v_o/v_s is 3.0 and the amplifier can be operated within 20 Hz to 20 kHz assume that the transistor has small-signal hybrid-π parameters, r_π = 3 kΩ, g_m = 40mA/V, $r_o = \infty$ and negligible device capacitances.

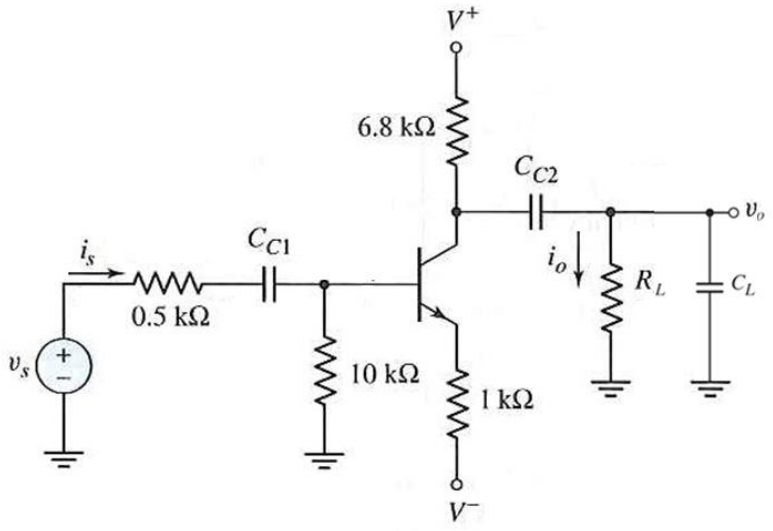

Fig. 2(a)

(b) A common drain amplifier is shown in **Fig.2 (b)** that operates at very high frequencies. The transistor parameters are: g_m = 0.2 mA/V and r_o = 300 KΩ, C_{gd} = 2 pF and cutoff frequency, f_T = 100 kHz. [Given that R_{si} = 2 kΩ, R_1 = 32 kΩ, R_1 = 18 kΩ, R_D = 4 kΩ, R_s = 2 kΩ, C_C = 10 µF and C_S = 100 µF]

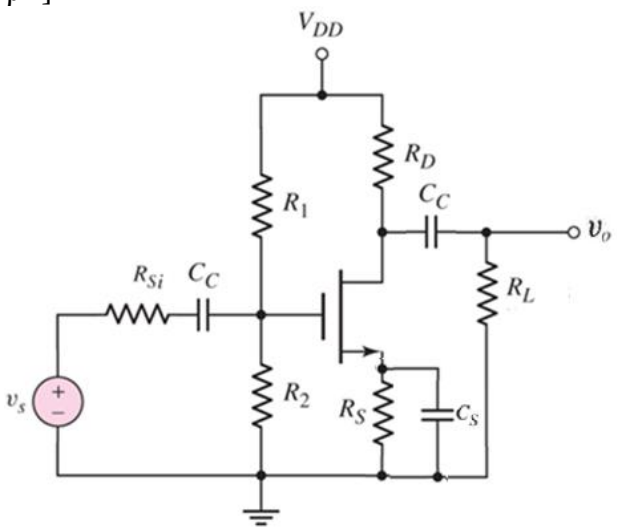

Fig. 2(b)

(i) Draw the simplified high-frequency small signal equivalent circuit diagram and Miller equivalent circuit diagram. **(2 marks)**

(ii) Write the expression of Miller capacitance and find its value. **(2 marks)**

(iii) Evaluate the upper 3dB frequency (f_H) considering Miller capacitance **(2 marks)**

(iv) Evaluate the upper 3dB frequency (f_H) without considering Miller capacitance. **(2 marks)**

(v) What is effect of miller capacitance and how do you consider bandwidth of the amplifier?

(2 marks)

Q.3 [20 marks]

(a) Design a Wilder current source in **Fig. 3(a)** to give an output current of $I_0 = 12\,\mu A$ and $I_R = 1.5\,mA$. The transistor parameters are $V_{BE1} = 0.7\,V$, $V_T = 26\,mV$, $V_{A1} = V_{A2} = 85\,V$ and $\beta_1 = \beta_2 = 75$. Also, calculate the output resistance R_0. **(6 marks)**

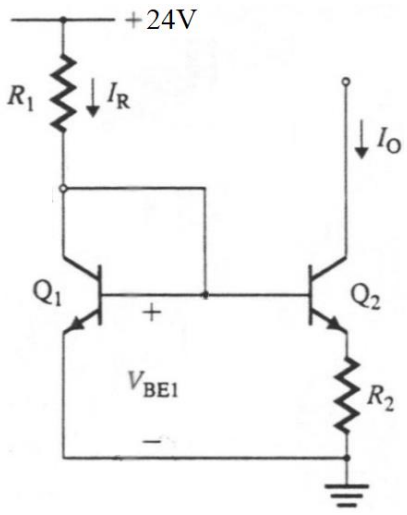

Fig. 3(a)

(b) Design a MOSFET current source to give three different output current as shown in **Fig. 3(b)** with a reference current $I_R = 15\ mA$. Assume that the channel constant K_x and the threshold voltage V_t are identical for all MOSFETs, also, consider that $\lambda = 0$. **(8 marks)**

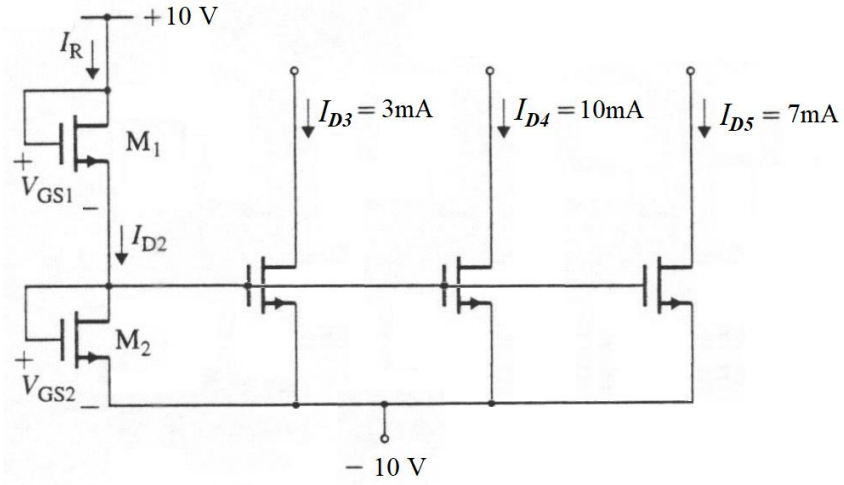

Fig. 3(b)

(c) What are the conditions for sustaining oscillation of an oscillator? Draw the schematic and design an Op-amp based variable frequency Wien-Bridge oscillator for generating frequencies range from 10 kHz to 15 kHz. **(6 marks)**

Q.4 [20 marks]

(a) Explain why there are only four types of topologies in feedback amplification systems. **(4 marks)**

(b) The feedback voltage v_{fb} and error voltage v_ε of a feedback amplifier are 5mV and 100μV respectively, determine the gain of the feedback amplifier. Assume that the open loop gain of the amplifier is 2500. **(4 marks)**

(c) The change of gain is 30% of a voltage amplifier without feedback. Draw the schematic and design a feedback amplifier to determine the feedback factor β_v so that the change of gain would be reduced to 10%. Assume that the open-loop gain of the amplifier is 60dB. **(6 marks)**

(d) The input resistance of a feedback current amplifier is $R_{if} = 750\Omega$. Determine the output resistance R_{0f}, bandwidth f_{BWf} and current gain A_{if} with feedback. Assume that the input resistance, output resistance, bandwidth and current gain without feedback of the amplifier are, $R_i = 5k\Omega$, $R_0 = 10k\Omega$, $f_{BW} = 55kHz$ and $A_i = 3500$ respectively. **(6 marks)**

USEFUL FORMULA

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

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