الجامعة الإسلامية العالمية ماليزيا
INTERNATIONAL ISLAMIC UNIVERSITY MALAYSIA
يونيورسيتي إسلام انتارابغسا ملايسيا

KULLIYYAH OF ENGINEERING

END OF SEMESTER EXAMINATION
SEMESTER I, 2020/2021 SESSION

Programme	: **Engineering**	Level of Study	: **UG 2**
Time	: 2**:30 pm - 5:30 pm**	Date	: **14/01/2021**
Duration	: **3 Hrs**		
Course Code	: **EECE 2312**	Section(s)	: **1-2**
Course Title	: **Electronic Circuits**		

This Question Paper Consists of **5 (Five)** Printed Pages (Including Cover Page)
with **4 (Four)** Questions.

INSTRUCTION(S) TO CANDIDATES

- Total mark of this examination is **80.**
- This examination is worth **60%** of the total course assessment.
- Answer **ALL QUESTIONS.**
- Marks assigned to each problem are listed in the margins.
- Online exam
- **Note that one of the conditions to pass the course is to obtain at least 50 % of this examination.**

DECLARATION

By answering this final examination, I hereby declare that:

- The whole answer of this final examination is my own work.
- I do not receive any help from any other parties in answering on any part of this final examination.
- I do not give any clue, hint or work to other students in answering on any part of this final examination.
- I understand that any form of cheating or attempt to cheat is a serious offence, which may lead to dismissal.

Question 1 [20 marks]

(a) Derive the transfer function step by step for the *RC*-circuit shown in **Fig. 1 (a)** the following standard format:

$$T(s) = k\frac{1 + s\tau_1}{1 + s\tau_2}$$

where, τ_1 and τ_2 are the two different time constants, and k is a frequency independent constant. **(7 marks)**

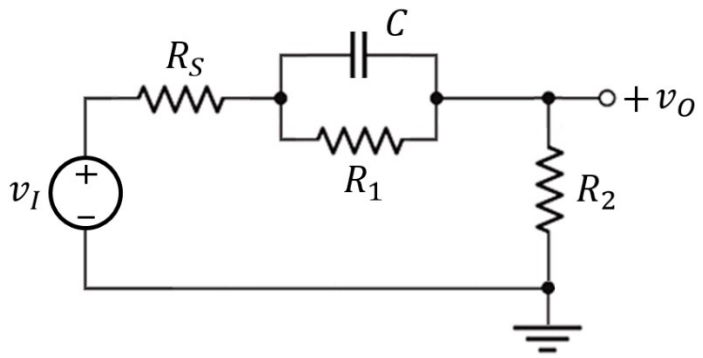

Fig. 1(a)

(b) Determine the -3 dB lower corner, upper frequencies and bandwidth of the circuit as shown in **Fig. 1(b)**. The circuit components are $R_1 = 2.5\ \text{k}\Omega, R_2 = 4.0\ \text{k}\Omega, C_1 = 150\ \text{pF}$ and $C_2 = 80\ \text{nF}$ respectively. **(3 marks)**

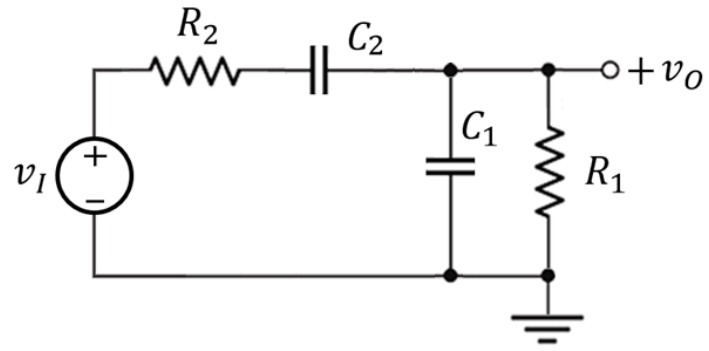

Fig. 1(b)

(c) Plot the Bode magnitude and phase for the following transfer function and determine the magnitude and phase at angular frequency 80 rad/sec. **(6+4 marks)**

$$T(s) = \frac{1.25 \times 10^{-3} s(s + 50)}{(s + 20)(s + 90)}$$

Question 2 [20 marks]

(a) The common emitter amplifier is shown in **Fig. 2(a)** with the following circuit component values $R_S = 5\ \text{k}\Omega$, $C_{C1} = 0.1\ \mu\text{F}$, $R_1 = 180\ \text{k}\Omega$, $R_2 = 85\ \text{k}\Omega$, $R_E = 0.5\ \text{k}\Omega$, $R_C = 3\ \text{k}\Omega$, and $R_L = 10\ \text{k}\Omega$. The BJT has AC small-signal hybrid-π parameters, $g_m = 50\ \text{mA/V}$, $r_\pi = 1.5\ \text{k}\Omega$ and $r_0 = \infty$. **(14 marks)**

i. Find the lower corner frequency due to C_{C1}.

ii. Design the amplifier circuit by considering the lower corner frequency is same due to C_{C1} and upper corner frequency, $f_H = 300\ \text{kHz}$.

iii. What is the bandwidth of the amplifier?

iv. Determine the maximum gain of the designed amplifier in dB.

v. What is the amplifier gain if R_S is bypassed by a large capacitance?

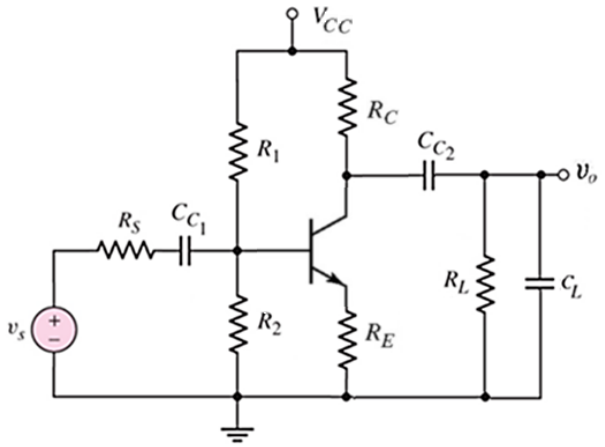

Fig. 2(a)

(b) The common source amplifier is shown in **Fig. 2(b)**. Assume that the MOSFET has small-signal high frequency parameters, $g_m = 2\ \text{mA/V}$, $r_o = 25\ \text{k}\Omega$, $C_{gs} = 20\ \text{pF}$ and $C_{ds} = 12\ \text{pF}$. Draw the Miller equivalent circuit and determine the Miller capacitance, C_M. **(6 marks)**

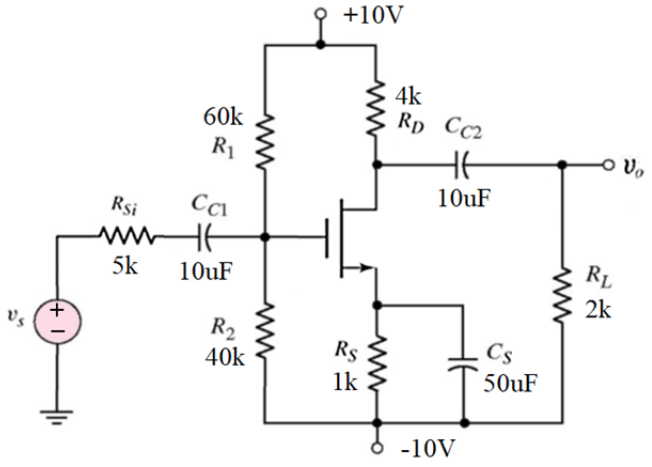

Fig. 2(b)

Question 3 [20 marks]

(a) Derive the expression for output current relation systematically of the BJT current source as shown in **Fig. 3(a)**. Assume that all the transistors are identical. **(6 marks)**

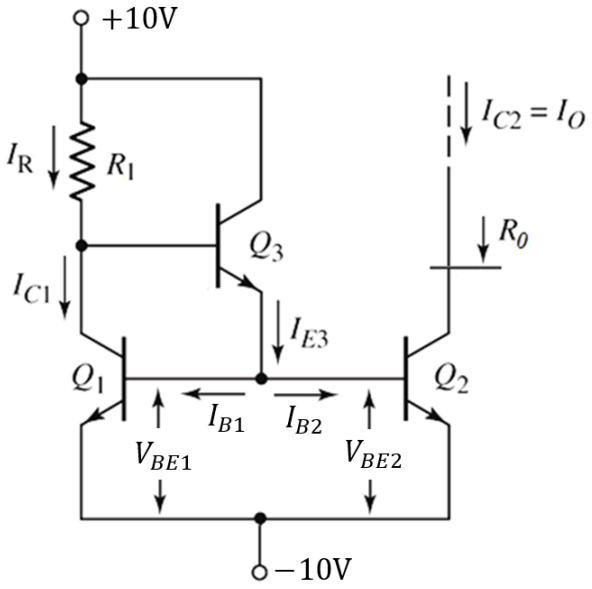

Fig. 3(a)

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

(c) Design the circuit by determining the value of R_1 and output resistance R_O for the current source as shown in **Fig. 3(a)**. Assume that the transistors has the parameters, $\beta = 35$, $V_{BE1} = V_{BE2} = V_{BE3} = V_{BE}(\text{on}) = 0.7\ \text{V}$, $V_A = 85\ \text{V}$, and $I_O = I_{C2} = 15\ \mu\text{A}$. **(6 marks)**

(d) Design the circuit to determine the (W/L) ratio for the MOSFET current source as shown in **Fig. 3(d)**. Assume that all MOSFET are identical and $I_{REF} = 1.2\ \text{mA}$. The MOSFET has the parameters $k_n' = 125\ \mu\text{A/V}^2$, $V_{TN} = 1.2\ \text{V}$ and $\lambda = 0$. **(6 marks)**

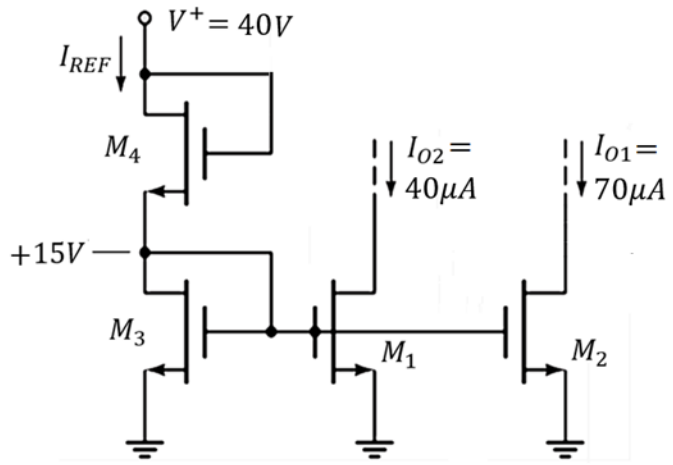

Fig. 3(d)

Question 4 [20 marks]

(a) The feedback current i_{fb} and error current i_{ε} of a feedback amplifier are 0.5 mA and 85 μA respectively. Determine the gain of the feedback amplifier. Assume that the open-loop gain of the amplifier is 2.5×10^4 Ω. **(5 marks)**

(b) The change of gain is 55% of a voltage amplifier without feedback. Design a feedback amplifier to determine the feedback factor β_v so that the change of gain would be reduced to 5%. Assume that the open-loop gain of the amplifier is 60 dB. **(5 marks)**

(c) The bandwidth of a voltage amplifier is extended 175 times after feedback. Determine the input and output resistances R_{if}, R_{0f} and voltage gain A_{vf} after feedback. Assume that the input resistance, output resistance and voltage gain without feedback of the amplifier are, $R_i = 10$ kΩ, $R_0 = 5$ kΩ, $A_v = 1500$ respectively and bandwidth of the amplifier without feedback is 5 kHz . **(5 marks)**

(d) Draw the schematic and design an Op-amp based phase-shift oscillator for generating frequency of 5.0 kHz. **(5 marks)**

END OF QUESTIONS