INTERNATIONAL ISLAMIC UNIVERSITY MALAYSIA

KULLIYYAH OF ENGINEERING

END OF SEMESTER EXAMINATION
SEMESTER I, 2022/2023 SESSION

Programme	: **Engineering**	Level of Study	: **UG 2**
Time	: **3:00 pm - 6:00 pm**	Date	: **27/01/2023**
Duration	: **3 Hrs**		
Course Code	: **EECE 2313**	Section(s)	: **1-3**
Course Title	: **Electronic Circuits**		

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

INSTRUCTION(S) TO CANDIDATES

- Total mark of this examination is **60.**
- This examination is worth **60%** of the total course assessment.
- Answer **ALL QUESTIONS.**
- Marks assigned to each problem are listed in the margins.
- Only approved calculator with **'KoE approved'** sticker is allowed (non-programmable and non-graphical).
- **Note that one of the conditions to pass the course is to obtain at least 50 % of this examination.**

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

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Question 1 [15 marks]

(a) Derive the transfer function step by step for the *RC*-circuit as shown in **Fig. 1 (a)** with 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. **(5 marks)**

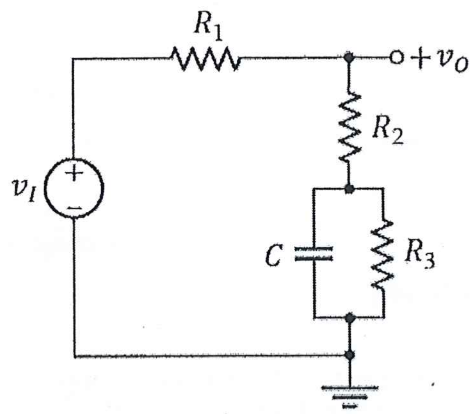

Fig. 1(a)

(b) Determine the −3 dB lower corner frequency, upper corner frequency and bandwidth of the circuit as shown in **Fig. 1(b)**. Consider that the circuit components are $R_1 = 4\ \text{k}\Omega$, $R_2 = 2\ \text{k}\Omega$, $C_1 = 10\ \text{nF}$ and $C_2 = 100\ \text{pF}$ respectively. **(4 marks)**

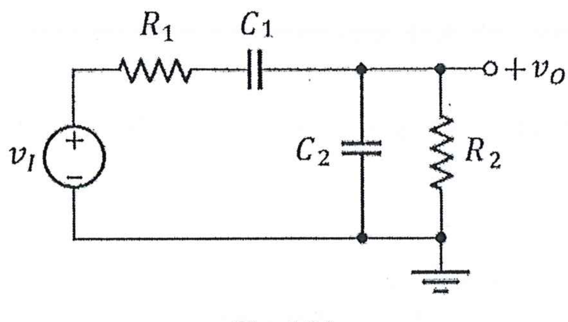

Fig. 1(b)

(c) Plot the Bode magnitude and phase for the following transfer function and determine the magnitude and phase at angular frequency 1500 rad/sec. **(4+2 marks)**

$$T(s) = \frac{10^{-5}\, s(s+300)}{(s+30)}$$

Question 2 [15 marks]

(a) The common emitter amplifier is shown in **Fig. 2(a)** with the following circuit component values $R_S = 2\ \text{k}\Omega$, $R_1 = 60\ \text{k}\Omega$, $R_2 = 30\ \text{k}\Omega$, $R_E = 0.5\ \text{k}\Omega$, $R_C = 5\ \text{k}\Omega$, and $R_L = 4.5\ \text{k}\Omega$. The BJT has AC small-signal hybrid-π parameters, $g_m = 150\ \text{mA/V}$, $r_\pi = 5\ \text{k}\Omega$ and $r_0 = 45\ \text{k}\Omega$. Assume that, $C_E = C_{C2} = \infty$. **(4+6 marks)**

i. Draw the small-signal equivalent circuit and determine the maximum gain of the amplifier in dB scale.

ii. Design the amplifier circuit for -3dB lower-corner frequency, $f_L = 20$ Hz and higher-corner frequency, $f_H = 20$ kHz.

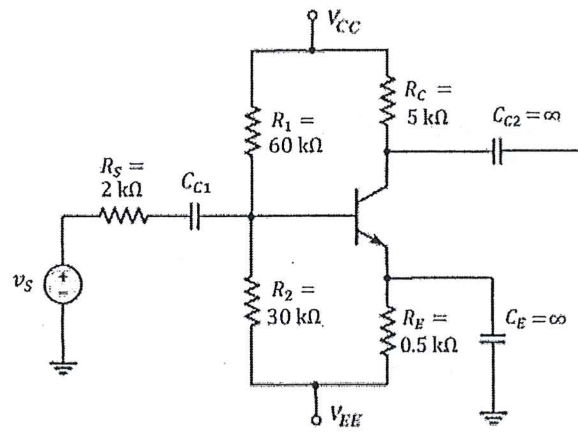

Fig. 2(a)

(b) The common emitter amplifier is shown in **Fig. 2(b)**. Assume that the transistor has small-signal high-frequency parameters, $g_m = 75\ \text{mA/V}$, $r_o = \infty$, $r_\pi = 3\ k\Omega$, $C_\pi = 10$ pF and $C_\mu = 1.5$ pF. Draw the simplified Miller high-frequency equivalent circuit and determine the -3dB higher corner frequency considering the miller capacitance effect. **(5 marks)**

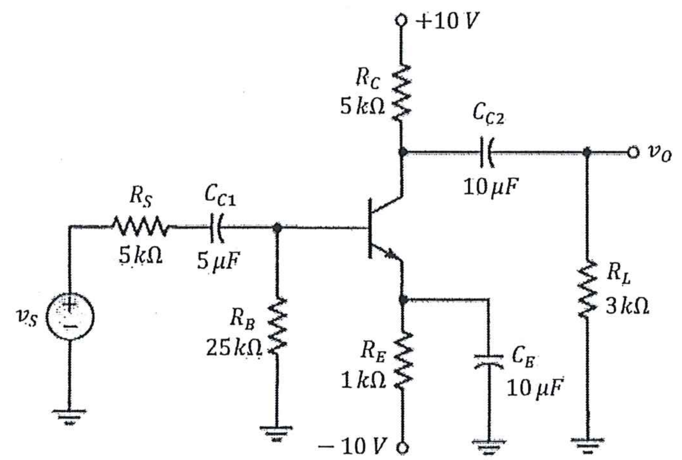

Fig. 2(b)

Question 3 [15 marks]

(a) Derive the expression for the BJT Wilson current source step by step as shown in **Fig. 3(a).** **(5 marks)**

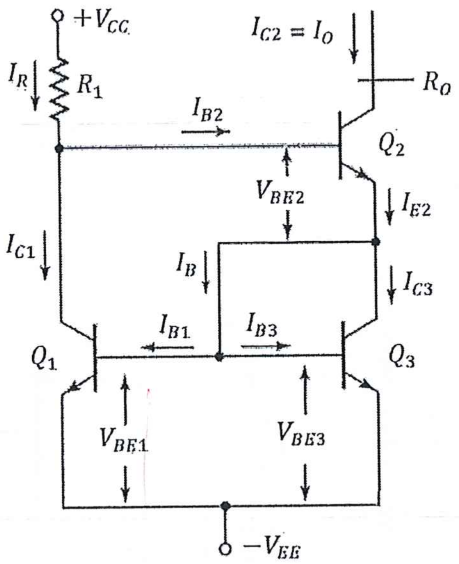

Fig. 3(a)

(b) Design the current source as shown in **Fig. 3(a)** for output current $I_O = 10\ \mu A$ and determine its output resistance R_O. Assume that all the transistors are identical, $V_{CC} = +10\ V$, $V_{EE} = -10\ V$, $V_{BE1} = V_{BE2} = V_{BE3} = 0.7$ V, $\beta = 10$, $V_A = 100$ V and $r_\pi = 5\ k\Omega$. **(4 marks)**

(c) An oscillator is an electronic circuit which produces a continuous, repeated, alternating waveform without any input.

i. What are the conditions for sustainable oscillation of a sine wave oscillator? **(2 marks)**

ii. Draw the schematic design of an Op-amp based Wien Bridge oscillator and design the circuit for generating a sine wave frequency of 2 kHz. **(4 marks)**

Question 4 [15 marks]

(a) Draw the equivalent circuit for the series-shunt feed-back amplifier as shown in **Fig. 4(a)**, and derive the expression step by step for A_{vf}, R_{if} and R_{of} of the amplifier. **(8 marks)**

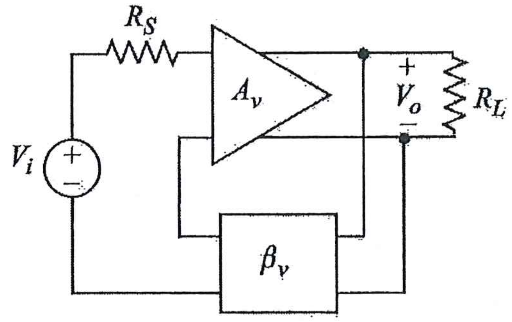

Fig. 4(a)

(b) The feedback voltage v_{fb} and error voltage, v_ε of a feedback amplifier are, 5.0 mV and 10 μV, respectively. Determine the gain, A_{vf}, input resistance, R_{if}, and output resistance, R_{of} after feedback of the amplifier. Assume that the gain of the amplifier without feedback is, 2.5×10^4. **(4 marks)**

(c) The change of gain is 26% of a current amplifier without feedback. Design the feedback amplifier to determine the feedback factor β_i so that the change of gain would be reduced to 2%. Assume that the open-loop gain of the amplifier is, $A_i = 1.3 \times 10^3$. **(3 marks)**

END OF QUESTION