PRESIDENCY UNIVERSITY
BENGALURU

SCHOOL OF ENGINEERING
END TERM EXAMINATION - JUN 2023

Semester : Semester IV - 2021
Course Code : ECE3001
Course Name : Sem IV - ECE3001 - Linear Integrated Circuits
Program : ECE

Date : 21-JUN-2023
Time : 9.30AM - 12.30PM
**Max Marks :** 100
Weightage : 50%

Instructions:
(i) Read all questions carefully and answer accordingly.
(ii) Question paper consists of 3 parts.
(iii) Scientific and non-programmable calculator are permitted.
(iv) Do not write any information on the question paper other than Roll Number.

PART A

ANSWER ALL THE QUESTIONS   (5 X 2 = 10M)

1. An integrator is an electronic circuit which will integrate the input waveform and produce an output voltage. Draw the diagram of a basic integrator.
                                                        (CO1) [Knowledge]

2. Voltage to current converters are devices which will convert a voltage into an equivalent current. These are used in many industries wherein current is transmitted instead of voltage. Draw the circuit of a voltage to current converter with a floating load.   (CO2) [Knowledge]

3. The following circuit was designed by Mr. Rinto and he wired this on the breadboard. Which LED will glow? Explain briefly.
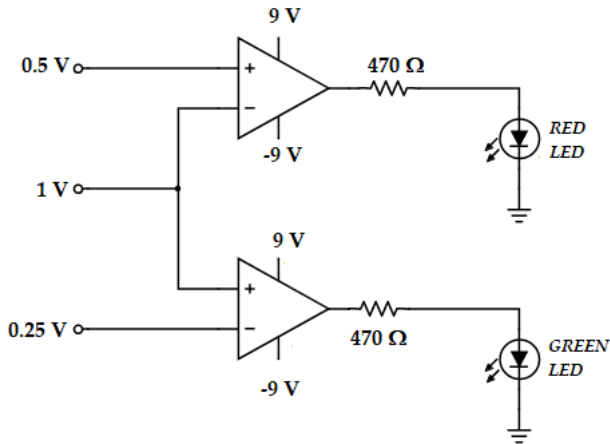
                                                        (CO3) [Knowledge]

4. Mr. Suraj is using an op-amp having a CMRR of 100 dB. If the differential gain of the op-amp is 1×10^6, obatin the common mode gain of the op-amp.

(CO1) [Knowledge]

5. Digital to Analog Converters are electronic circuits which will convert an n - bit digital data into an equivalent analog voltage. List the resistors required if we are using a 5 bit binary weighted DAC.

(CO3) [Knowledge]

PART B

ANSWER ALL THE QUESTIONS   (2 X 15 = 30M)

6. 555 timer IC may be used to generate accurate time delays. Explain with the help of a circuit diagram and the internal block diagram, how the 555 timer can be used as an astable multivibrator. Using the circuit estimate the component values that should be used for generating a square wave with a frequency of 4 kHz and a duty cycle of 60%. Use a capcitor of $0.01\ \mu F$. Draw the voltage across the capacitor and the output voltage developed in this case. Use a V_{CC} of 12 V.

(CO3) [Comprehension]

7. Mr. Rinto is a design engineer at Texas Instruments®. He is having a signal coming from a particular system which is given below.

$v_{in}(t) = sin(30\pi t) + sin(60000\pi t)$

Mr. Rinto wants to remove only the low frequency component in the signal. He has the following filters available.

- First order Active Low Pass Filter with a cut off frequency of 50 kHz and pass band gain of 3
- First order Active Low Pass Filter with a cut off frequency of 2000 Hz and pass band gain of 3
- First order Active High Pass Filter with a cut off frequency of 50 kHz and pass band gain of 3
- First order Active High Pass Filter with a cut off frequency of 2000 Hz and pass band gain of 3

Identify the filter that Mr. Rinto could use to meet the specification? Draw the circuit of the filter. Estimate the resistor values to be used, if the capacitor value available is $0.01\ \mu F$. Infer the steady state output expression when the given input is applied to the designed filter.
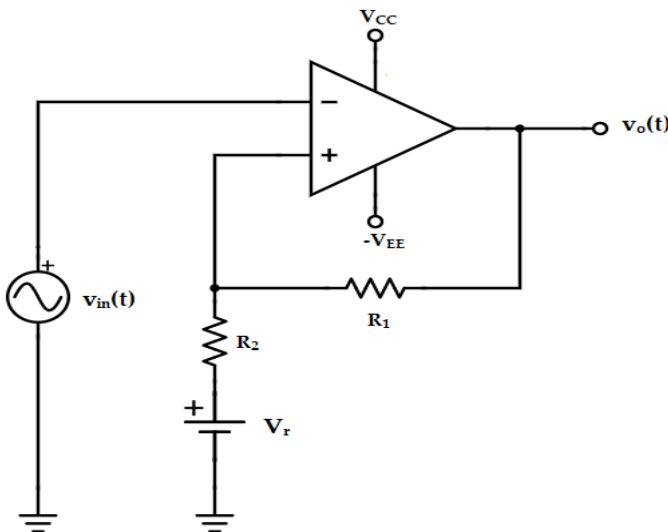
(CO3) [Comprehension]

PART C

ANSWER ALL THE QUESTIONS   (3 X 20 = 60M)

8. **Part (a)** Mr. Rinto is an engineer and wants to design the following modified circuit of a Schmitt Trigger.

Show that the triggering points are as below.
$$V_{UTP} = \beta V_{sat} + (1 - \beta)V_r$$

$$V_{LTP} = -\beta V_{sat} + (1 - \beta)V_r$$

Here $\beta = \dfrac{R_2}{R_1 + R_2}$ and V_{sat} is the saturation voltage.

Now estimate the values of the circuit if need the triggering points to be -3 V and 6 V. Given that the saturation voltage is 12 V. Now sketch the input voltage, output voltage and the transfer characteristics if the input is 20 V peak to peak sinewave.

Part (b) Draw the circuit diagram of a triangular wave form generator using op-amp. Estimate the values of the components to be used so that a 4 kHz triangular waveform with a peak to peak voltage of 10 V is generated. Use a capacitor of $0.01\ \mu F$ and saturation voltage of $V_{sat} = 15\ V$.

(CO3) [Application]

9. **Part (a):** In a certain transmission, a digital data is coming as 101. Draw a circuit that will convert it into an equivalent analog data if you have any number of the following resistors.
$10\ k\Omega, \quad 20\ k\Omega$
Analyze the circuit and find the output equation. Tabulate the voltage that will be produced in each case if the reference voltage used is $4\ V$

Part (b): In a certain application, it is required to convert an analog voltage to its equivalent 3 bit digital voltage using the fastest method. Explain the working of the device that you would use in this case with a neat diagram.

(CO3) [Application]

10. **Part(a)** Mr. Vivek is working as a design engineer working with a thermocouple. A thermocouple is a device which measures temperature. The output from a thermocouple is a differential voltage, which has to be given to an amplifier with two inputs and having a high input impedance, and whose gain can be controlled using a single variable control. Which amplifier should he use? Draw the circuit and estimate the component values if the gain required is between 200 and 300.

Part(b) Mr. Kiran is a design engineer at Analog Devices®. He has come up with a circuit to convert the input current to equivalent output voltage as below.
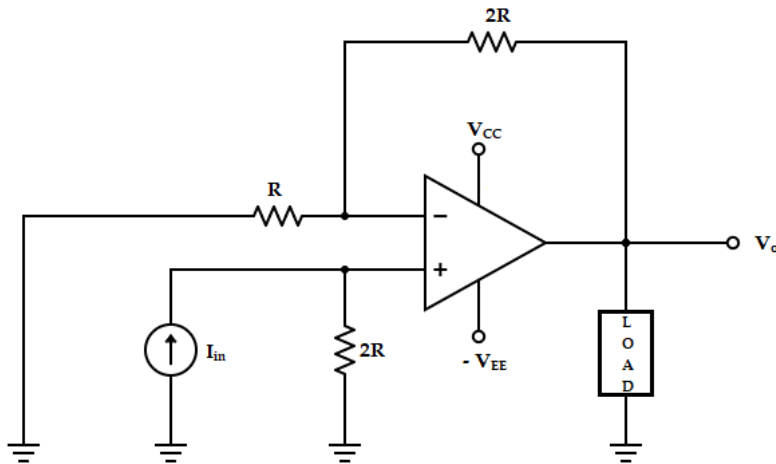
Analyze the circuit and prove that the circuit is indeed a current to voltage converter. If the value of R is $2\ k\Omega$, the load is a $250\ \Omega$ resistor, and $I_{in} = 3\ mA$, evaluate the current from the output pin of the op-amp?

(CO2) [Application]