PRESIDENCY UNIVERSITY
BENGALURU

SCHOOL OF ENGINEERING
<u>MID TERM EXAMINATION - APR 2023</u>

Semester : Semester IV - 2021   **Date :** 17-APR-2023
Course Code : ECE3001   **Time :** 9:30AM - 11AM
Course Name : Sem IV - ECE3001 - Linear Integrated Circuits   **Max Marks :** 50
Program : ECE   **Weightage :** 25%

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. Operational amplifiers can be used in open loop. But in this case, the gain is very high. Consider one such circuit shown below. The open loop gain of the op-amp is given as 4×10^5.
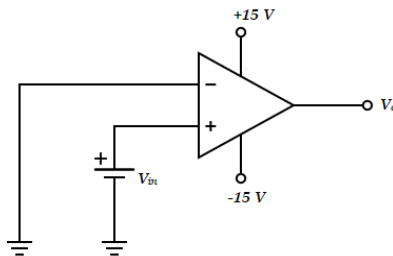
    Identify the output voltage if the input is
    (a) $0.5 \ \mu V$
    (b) $4 \ V$ (CO1) [Knowledge]

2. Operational amplifiers are multi stage high gain amplifiers, which can perform several mathematical operations, and other non linear applications. Reproduce the equivalent circuit of an op-amp
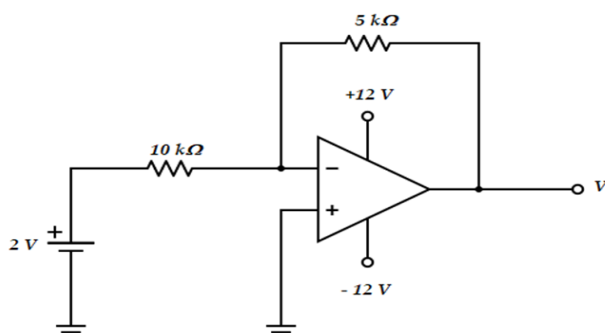   (CO1) [Knowledge]

3. An op-amp is a multistage, direct coupled high gain amplifier. With respect to an op-amp, define the following terms:
    (a) Input Offset Voltage   (CO1) [Knowledge]
    (b) Input Offset Current

4. Amplifiers are elctronic circuits which will amplify an input signal and produce a corresponding output. For the amplifier circuit shown below, the output voltage would be _____ V

                                                                (CO2) [Knowledge]

5. A voltage follower is a circuit whose output voltage is equal to the input voltage (it follows the input voltage). Reproduce the circuit of a voltage follower using op-amp.

(CO2) [Knowledge]

PART B

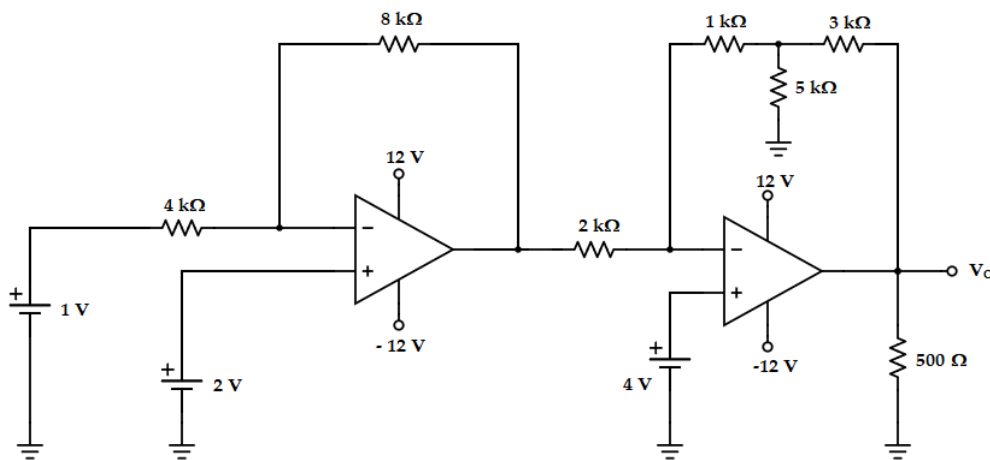**ANSWER ALL THE QUESTIONS**   **(2 X 10 = 20M)**

6. Part (a) Mr. Suraj is a design engineer in ARM®. He is designing an amplifier for a gain of 20 dB. For this purpose he has an op-amp with a slew rate of $8\ V/\mu s$. He wants to amplify signals with a maximum amplitude of 200 mV. Help him by estimating the maximum frequency that can be applied to the amplifier. [6 Marks]

Part (b) A certain amplifier is having a CMRR of 180 dB. Estimate the common mode gain of the amplifier in linear scale and dB scale if the differential mode gain is 1×10^6. [4 Marks]

(CO1) [Comprehension]

7. Dr. Pritam designed a circuit using op-amp to perform a certain mathematical operation. The circuit is shown below.

Analyze the circuit and obtain the output voltage.

(CO2) [Comprehension]

PART C

ANSWER ALL THE QUESTIONS   **(2 X 10 = 20M)**

8. Mr. Vivek is a Control Engineer at Kochi Refineries Limited. He wants to use a certain Controller on a certain Boiler control system. The mathematical expression for the Controller is given below

$$v_o(t) = 4 \int v_1(t)\ dt + 10.\frac{dv_2(t)}{dt}$$

Here $v_1(t)$ and $v_2(t)$ are error voltages coming from the system.

Help him by drawing a circuit which will perform the above expression. Estimate the values of the components to be used. Use capacitors of $100\ \mu F$.

(CO2) [Application]

9. Operational amplifiers were given that name because it was capable of performing mathematical operations. Suppose you want to do the perform the mathematical operation given by

$$V_o = 2V_2 - 6V_1$$

Draw the circuit diagram which will perform the above mathematical operation. Estimate the resistor values to be used.

(CO2) [Application]