Reg. No.									

MANIPAL INSTITUTE OF TECHNOLOGY

MANIPAL

(A constituent unit of MAHE, Manipal)

IV SEMESTER B.TECH (ELECTRICAL & ELECTRONICS ENGINEERING)

END SEMESTER EXAMINATIONS, APRIL-MAY 2024

ANALOG SYSTEM DESIGN [ELE2221]

REVISED CREDIT SYSTEM

Time: 3 Hours **Date: 30 April 2024** **Max. Marks: 50**

Instructions to Candidates:

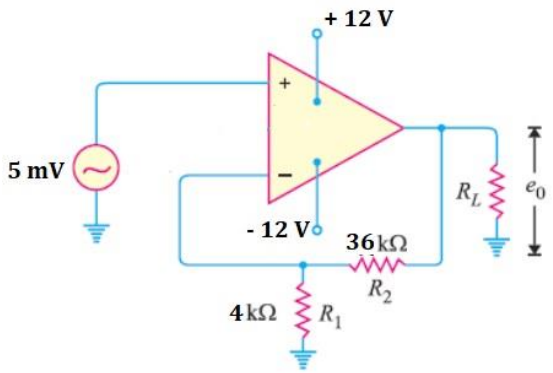
- Answer **ALL** the questions.
- Missing data may be suitably assumed.

1A. An OPAMP amplifier with a gain of 10 is used to amplify a sinusoidal signal whose peak amplitude is 0.5V. The frequency of the sinusoidal signal is 25 kHz. From the fundamental, derive the expression for the slew rate of the OPAMP and further, through appropriate calculations, determine the minimum slew rate of the OPAMP in use for this amplification to be successful. ***(03)***

1B. Design a practical integrator circuit using OPAMP to integrate the input signals from 100 Hz. Ensure the unity gain of the circuit is at 1 kHz. Sketch the magnitude plot of the output waveform with input if a square waveform (peak to peak of 2 V) is given as input at 2 ms. Assume the feedback capacitance to be 0.1µF. ***(04)***

1C. For the active circuit shown in Fig. Q1C, determine the following parameters:

- The feedback fraction
- The overall voltage gain
- The output voltage considering the application of 5mV at the input

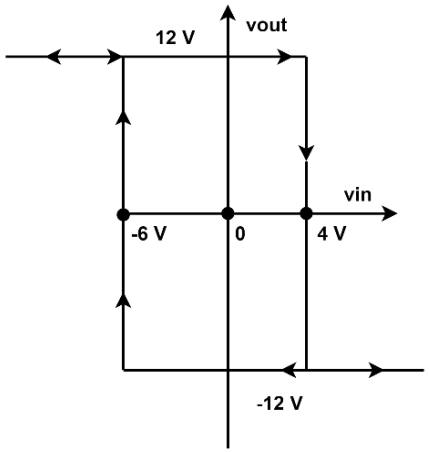


(03)

2A. The frequency range of different instruments playing a musical track is as shown in the table. Assume the overall passband gain of 20 dB, feedback resistance of 100 kΩ, and a capacitance of 0.1 µF. Design a suitable first-order active filter that ensures a predominant audio if the hand drums through the loudspeaker. Draw the complete schematic of the design with appropriate labels. ***(04)***

Instrument	Frequency range
Hand drums	50 – 250 Hz
Flute	300 – 2 kHz
Electric guitar	3 kHz – 8 kHz

2B. Design an inverting Schmitt trigger circuit to get the transfer characteristics as shown in the figure. Draw the corresponding output voltage waveform with respect to time. The input is $V_{in} = 10\sin(314t)$. *A*ssume the resistance connected between the non-inverting terminal and ground to be 10 KΩ. Assume ± VSAT of OPAMP 741 is ±12 V and cut-in voltage of the diode is 0.7 V.

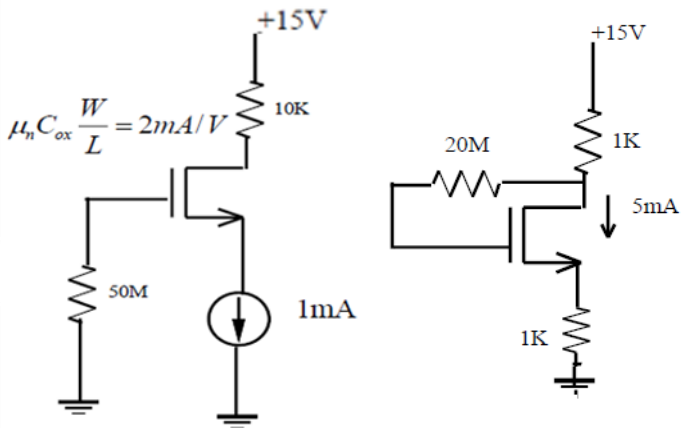


(04)

2C. Describe the working of a half-wave precision rectifier with a neat circuit diagram. ***(02)***

3A. Design a 555-timer-based monostable multivibrator to generate a pulse for 30µs. Also, design a negative edge trigger circuit to trigger the circuit by a 500 Hz square wave. Verify if the possible output can be generated for the given signal. Draw the circuit connections and the output waveforms. Assume available capacitors are of value C=0.01uF. ***(04)***

3B. For the MOSFET Amplifier circuit shown in the figure, determine the DC operating voltages V_{GS}, V_G, V_D, and V_S. Assume V_{th} = 0.5 V.

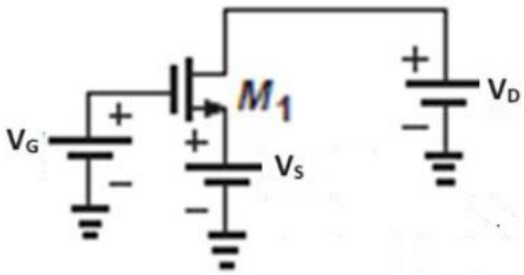


(04)

3C For the circuits shown below if Vth = 0.4 V, determine the region of operation for

i. V_G = 1.5V ; V_D = 1V ; V_S = 0.5V

ii. V_G = 1V ; V_D = 2V ; V_S = 0.7V

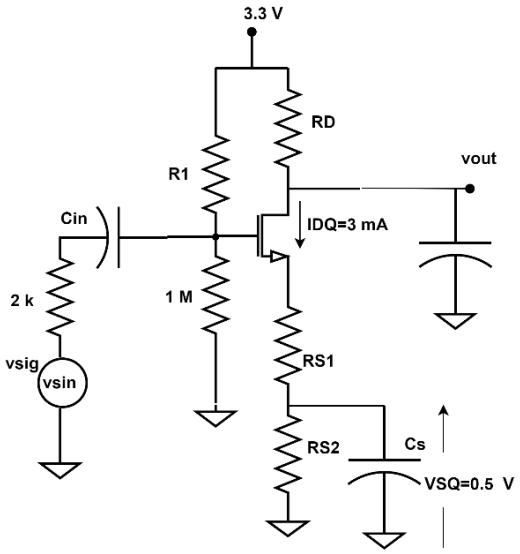


(02)

4A. Find the transconductance and VGS of n channel MOSFET. Vth= 1 V, $\mu nCox$ = 100 $\mu A/V2$, W/L = 6⁄ Assume ID(sat)=2 mA ***(03)***

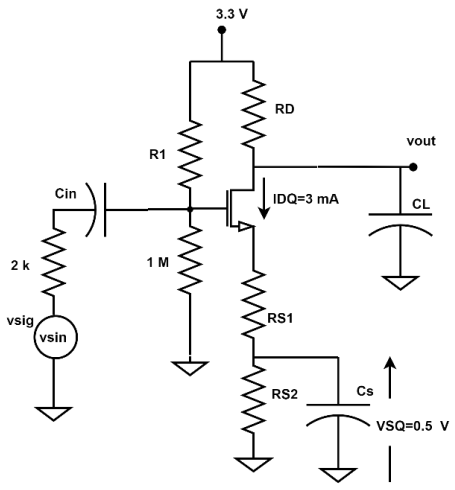
4B Design RC coupled amplifier circuit if passband gain is 30 dB. Assume the overdrive voltage VGS- VTH= 0.5 V. Assume RS1= 200 Ohms.

Draw the small signal model of the same.



(04)

4C. Determine the value of CIN, CL, and CS for the RC coupled amplifier shown in the fig for lower cut-off frequency 1 KHz and 10 KHz.



(03)

5A. A class B power amplifier providing 28 V peak signal to a 12 Ω load (speaker) and a power supply

of |VDD|=|VSS|=30 V, determine the input power, output power, and circuit efficiency. ***(03)***

5B. Identify and justify the different classifications of the Power Amplifiers based on their operating principles. ***(02)***

5C. A MOS differential pair operated at a bias current of 8 mA employs transistors with (W/L) =6 and μnCox=20 mA/V2, using RD=10 kΩ and RSS= 100 kΩ.

i. Find the Common mode Rejection ratio if the output is taken as single-ended and the circuit is perfectly matched.

ii) 0If we supply differential input voltage vid=400 mV, assess OPAMP's mode of operation (linear mode or non-linear mode).

(05)