Reg. No.										

MANIPAL INSTITUTE OF TECHNOLOGY
MANIPAL
(A constituent unit of MAHE, Manipal)

IV SEMESTER B.TECH. (ELECTRICAL & ELECTRONICS ENGINEERING)

MAKEUP EXAMINATIONS, JUNE 2024

ANALOG SYSTEM DESIGN [ELE 2221]

REVISED CREDIT SYSTEM

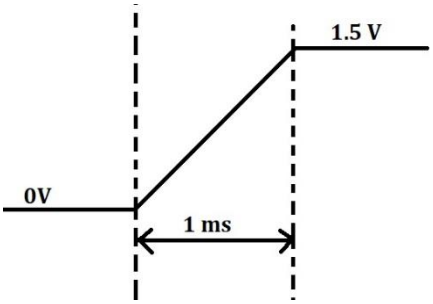
Time: 3 Hours **14 June 2024** **Max. Marks: 50**

Instructions to Candidates:

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

Q1A An OPAMP amplifier with a gain of 5 is used to amplify a sinusoidal signal whose peak amplitude is 0.5V. The frequency of the sinusoidal signal is 30 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. **3M**

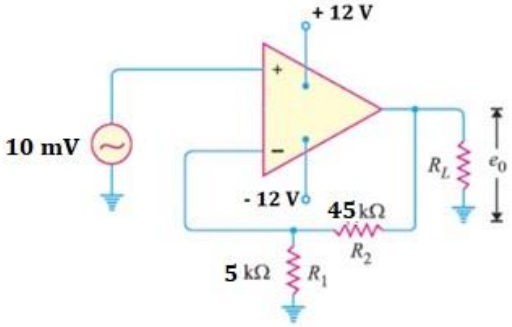
Q1B A ramp voltage of 1.5 V as shown below is given as an input to an OPAMP based differentiator circuit having a resistance of 2 kΩ and capacitance of 0.01μF. From the fundamentals, perform the necessary analysis to determine the corresponding output voltage and sketch the output voltage waveform.



4M

Q1C 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



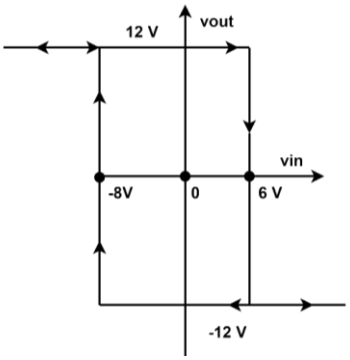
3M

Q2A 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 capacitance of 0.01μF. Design a suitable first-order active filter that ensures predominant audio of the electric guitar through the loudspeaker. Draw the complete schematic of the design with appropriate labels.

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

4M

Q2B 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 $V_{in} = 10\sin(314t)$ .Assume the resistance connected between the non-inverting terminal and ground to be 33 kΩ. Assume ± V_{SAT} of OPAMP 741 is ±12 V and the cut-in voltage of the diode is 0.7 V.

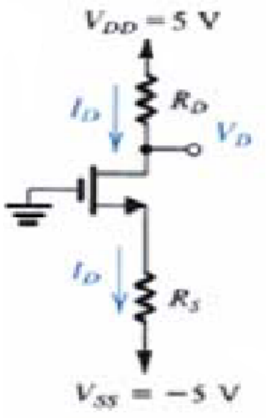


4M

Q2C Analyse the working of a peak detector with a neat circuit diagram **2M**

Q3A Design a 555-timer based circuit to generate mono-pulse with adjustable time-period of 0.2ms to 1.3 ms. Draw the circuit connections and the output waveforms. Assume available capacitors are of value C=0. 1uF **4M**

Q3B Design a circuit so that MOSFET operates at saturation region with ID=0.4 mA and VD=1V. Vth=2v . $\mu nCox$ = 20 $\mu A/V^2$.

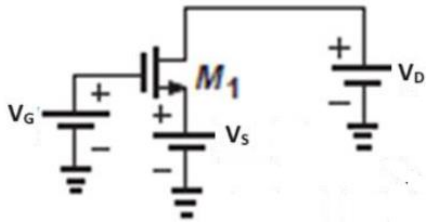


4M

Q3C For the circuits shown below if V_{th}= 0.4 V, determine the region of operation for **2M**

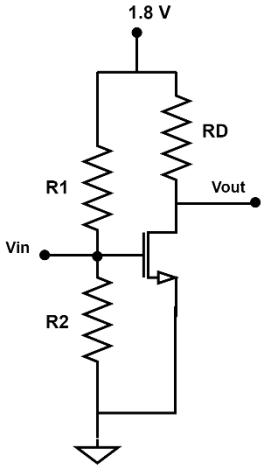
i. V_G = 1.5V ; V_D = 1V ; V_S = 0.5V

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



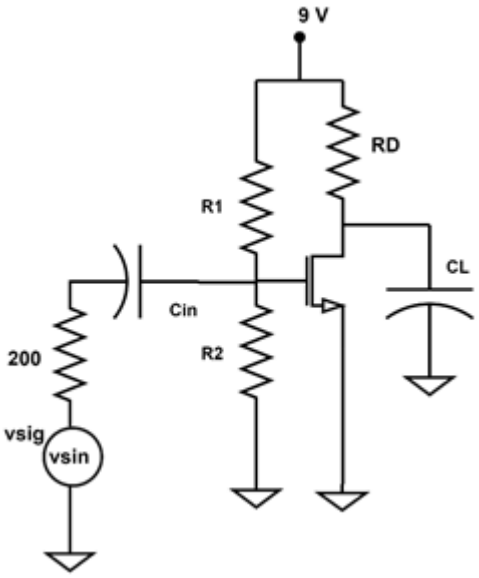
Q4A Find the MOSFET transconductance and gate to source voltage of n channel MOSFET. Vth= 1 V, $\mu nCox$ = 200 $\mu A/V^2$, W/L = 10. Assume ID(sat)=10 mA **3M**

Q4B Design a common source stage for a voltage gain of 5 with the following specifications. $\mu_n C_{ox} = 100\, uA/V^2$ Vth= 0.5 V, VDD=1.8 V $I_{R1}$and I_{R2}= 77 uA. VGS= 1 V. Power delivered by the source is 5 mW.



4M

Q4C MOS amplifier with the configuration below is to be designed for use in a telephonic circuit. The magnitude of voltage gain should be 10 V/V in the mid-band frequency and should extend from 200 Hz to 20 KHz. Assume VDS=5 V, VGS=4V ID=2 mA and R2 =1 kOhm. Find R1, RD, Cin and CL



3

Q5A A class B power amplifier providing 22V peak signal to a 5Ω load (speaker) and a power supply of |VDD|=|VSS|=24V, determine the input power, output power, and circuit efficiency. **3M**

Q5 B Explain the push-pull configuration of Class B power amplifier with relevant circuit diagram and input/output voltage graph. **2M**

Q5C A MOS differential pair operated at a bias current of 5 mA employs transistors with (W/L) =10 and μnCox=10 mA/V2, using RD=1 kΩ and RSS= 50 kΩ. Find the differential gain, and the common mode gain if the output is taken as single-ended and the circuit is perfectly matched. If we supply differential input voltage vid=500 mV, assess OPAMP's mode of operation (linear mode or non-linear mode). Explore the limitation of OPAMP with respect to the linearity with the help of a current verses differential input voltage graph **5M**