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Question Paper Code:R4B05

B.E./B.Tech. DEGREE EXAMINATION, APRIL / MAY 2025

Fourth Semester

Biomedical Engineering

R21UBM405- ANALOG INTEGRATED CIRCUITS

(Regulations R2021)

Duration: Three hours | Maximum: 100 Marks

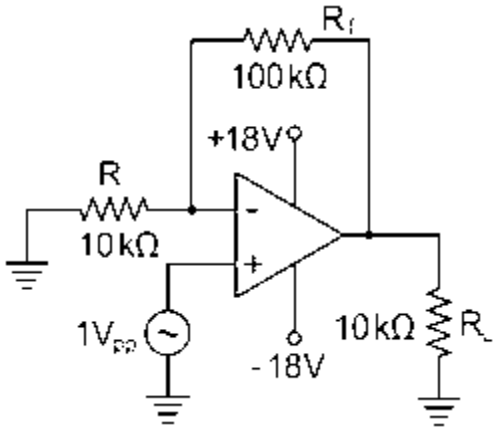
Answer ALL Questions

PART A - (10 x 2 = 20 Marks)

1.	What are the five ideal characteristics of an operational amplifier, and how do they influence its performance in circuit applications?	CO1- U
2.	What are the different stages of an operational amplifier, and what is the function of each stage in its overall operation?	CO1-U
3.	Draw the transfer characteristics of ideal comparator and practical comparator	CO1- U
4.	How do logarithmic and antilogarithmic amplifiers work, and what are their basic differences?	CO1- U
5.	The conversion rate of 8 bit ADC is 9 μs. Find the maximum frequency of the input sine wave that can be digitized.	CO2- App
6.	Why is a flash-type ADC faster compared to other ADC types, and how does its architecture contribute to its speed?	CO1- U
7.	What is the formula for the cutoff frequency of a simple RC low-pass filter?	CO1- U
8.	What is the purpose of input and output capacitors in three-terminal IC regulators?	CO1- U
9.	How does a VCO generate a frequency-dependent output, and why is it essential in PLL operation?	CO1- U
10.	List and explain the key features of the LM380 audio power amplifier.	CO1- U

PART – B (5 x 16= 80 Marks)

11.	(a)	Derive the expression of Non inverting amplifier with neat diagram and also For a given non-inverting amplifier shown in figure below. Find closed loop configuration?	CO2- App	(16)



Or

(b) Design an inverting amplifier with a voltage gain of -10. Assume an ideal operational amplifier and resistors with values you choose. The input signal has an amplitude of 0.1 V and a frequency of 1 kHz. The op-amp's supply voltage is ±15 V. CO2- App (16)

i. Calculate the resistor values required for the feedback and input resistors.
ii. Design the circuit.
iii. Calculate the input and output impedances of the amplifier.
iv. Analyze the effect of changing the input signal frequency on the output signal.

12. (a) Design and derive equations for adder, subtractor, scale changer, and voltage follower circuits using an operational amplifier, illustrating their working principles with circuit diagrams and practical applications. CO2-App (16)

Or

(b) (i) Design a lossy integrator circuit with R1 = 20 kΩ, Rf = 200 kΩ, Cf = 0.01μF. Determine the lower frequency limit and analyze the input, output waveforms of square wave and triangular wave with 5 V(p-p) and 10 ms. CO2-App (8)

(ii) Design an integrator circuit and a Schmitt trigger, providing circuit diagrams and explaining their working principles in detail, including practical application CO2-App (8)

13. (a) How does the R-2R ladder DAC generate an output current based on digital input codes, and what factors determine the short-circuit current? CO4-App (16)

Or

	(b)	(i) In the R-2R 4-bit converter, R = 10 kΩ and VR = 10 V. Determine the value of Rf that should be connected to achieve the following output conditions: A) The value of 1 LSB at the output of 0.5 V B) An analog output of 6 V for a binary input 1000 C) The full-scale output voltage of 12 V D) The actual maximum output voltage of 10 V	CO4- App	(8)
		(ii) An 8-bit A/D converter accepts an input voltage signal of range 0 to 9 V. What is the minimum value of the input voltage required for generating a change of 1 least significant bit? Specify the digital output for an input voltage of 4 V. What input voltage will generate all '1's as the A/D converter output?	CO4- App	(8)
14.	(a)	Design an adjustable voltage regulator circuit using the LM317 to achieve an output voltage range of 5V to 9V with a maximum load current of 1A, and justify the selection of resistor and capacitor values for optimal operation.	CO3-App	(16)
		Or		
	(b)	Critically assess the performance of the IC 723 in voltage regulation, considering its advantages and limitations in practical applications.	CO3-App	(16)
15.	(a)	Design an analog multiplier circuit using an emitter-coupled transistor pair, and propose an application-specific implementation using an analog multiplier IC.	CO3-App	(16)
		Or		
	(b)	Design a circuit using an optocoupler for electrical isolation in high-voltage applications, and develop a frequency-to-voltage converter circuit with an appropriate block diagram, explaining its functionality in detail.	CO3-App	(16)