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Question Paper Code: 41344

B.E. / B.Tech. DEGREE EXAMINATION, NOV 2016

Fourth Semester

Electrical and Electronics Engineering

14UEE404 - ANALOG INTEGRATED CIRCUITS

(Common to Instrumentation and Control Engineering)

(Regulation 2014)

Duration: Three hours

Maximum: 100 Marks

Answer ALL Questions

PART A - (10 x 1 = 10 Marks)

1. Integrated Circuits (IC's) are used in

(a) Linear Devices only	(b) Digital Devices only
(c) Both Linear and Digital Devices	(d) None of these

2. The active components in an Integrated Circuits (IC's) are

(a) Resistors	(b) Capacitors
(c) Transistors and Diodes	(d) None of these

3. If the currents flowing towards the inverting and non-inverting terminals of an Op-amp are 3 μ A and 1 μ A respectively, the bias current and the input offset current are

(a) 3 μ A and 1 μ A	(b) 2 μ A and 2 μ A
(c) 3 µA and 2 µA	(d) 1 μ A and 2 μ A

4. For the Op-amp configuration shown in Fig., the gain required is 61. Determine the appropriate value of feedback resistance R_1 Assume $R_2=1 \text{ k}\Omega$



(a) 55 ohm (b) 60 ohm (c) 62 ohm (d) 50 ohm

- 5. In applications where measurement of a physical quantity is involved, the Op-amp circuit recommended is
 - (a) Basic non-inverting amplifier
 - (c) An active filter (d) An instrumentation amplifier

(b) A comparator

- 6. In a sample and hold circuit the following statement is false
 - (a) Sample time is much smaller than hold time
 - (b) Aperture time is the delay between the time that the pulse is applied to the switch and the actual time the switch closes
 - (c) Acquisition time is the time it takes for the capacitor to charge from one voltage to another voltage
 - (d) The voltage across the hold capacitor changes by 50% during hold time
- 7. Which of the following techniques are used for the analog multipliers?
 - (a) Logarithmic multipliers(b) Variable trans-conductance multipliers(c) Both (a) and (b)(d) None of these
- 8. In the Voltage Controlled Oscillator (VCO) circuit, the various parameters are R=10 k Ω , C=1.25 nF, V_{UT}=10 V and V_{LT} = 0 V. If input is changed from 10 mV to 10 V, the range of the output frequency can be varied from

(a) 10 Hz to 10 kHz	(b) 100 Hz to 10 kHz
(c) 10 Hz to 100 kHz	(d) 10 kHz to 100 kHz

9. Many types of IC regulator chips are available, some of which provide fixed voltages, while other can be

(a) Programmed	(b) Biasing voltage
(c) Non-programmed	(d) None of these

10. A major advantage of all switching regulators is

(a) Low Noise	(b) High Output Impedance
(c) High Efficiency	(d) All the above

PART - B (5 x
$$2 = 10$$
 Marks)

- 11. Classify the Integrated Circuits (IC's) in terms of function, device and technology.
- 12. An inverting amplifier has R_F = 500 k ohm and R_1 =5 k ohm. Determine the amplifier circuit voltage gain, input resistance and output resistance. Determine also the output voltage and input current if the input voltage is 0.1 V. Assume Op-amp to be ideal one.
- 13. For a second order low-pass filter, calculate the cut-off frequency and pass band voltage gain if the component values are R_1 = 12 k ohm, R_F = 7 k ohm and R_2 = R_3 = 33 k ohm and C_1 = C_2 = 0.002 µF.
- 14. Enumerate the features of 555 Timer Integrated Circuits.
- 15. Mention the limitations of linear IC voltage regulators. What is the order of the voltage drop across the current limiting resistor in an IC regulator when the limiting action occurs.

PART - C (5 x
$$16 = 80$$
 Marks)

- 16. (a) Mention the dimensions of a typical Integrated Circuits and different types of packaging of IC's. List the steps involved in the manufacturing process of an Integrated Circuits. Discuss the following processes in the monolithic IC technology with necessary diagram wherever necessary.
 - (i) Epitaxial Growth, (ii) Isolation by diffusion. (16)

Or

(b) How is electrical isolation achieved among the different components fabricated in the Integrated Circuits? Discuss. Why are the transistors modified as diodes in IC diode fabrication? Draw the different diode configuration obtainable from the transistor structure. Which configuration is generally used? Discuss. Enumerate the types of resistors fabricated in IC's and comment on the choice of the type with respect to the resistance values. (16)

- 17. (a) (i) An IC 741 op-amp whose slew rate is 0.5 V/μs is used as an Inverting Amplifier with a gain of 50. The voltage gain against frequency curve of IC 741 is flat upto 20 kHz. Evaluate what maximum peak to peak signal can be applied without distorting the output.
 - (ii) For a practical integrator, the component values are $R_1 = 120 \text{ k}\Omega$, $R_F = 1.20 \text{ M}\Omega$ and the capacitor $C_F = 10 \text{ nF}$. Draw the circuit diagram. Determine the safe frequency above which true integration will take place and DC gain. Find the peak of the output voltage for a sine wave input with 5 V peak and 10 kHz frequency. Sketch the rough nature of the frequency response. (10)

Or

- (b) (i) The Common Mode Rejection Ratio (CMRR) of an Op-amp is 10^4 . Two sets of signals are applied to it. First set is V_1 = + 20 μ V, V_2 = 20 μ V and second set V_1 = 540 μ V, V_2 = 500 μ V. Calculate the percent difference in output voltage for the two sets of signals. (6)
 - (ii) Design an op-amp differentiator that will differentiate an input signal with $f_{max} = 100$ Hz. Draw the output waveform for a sine wave of 1 V peak at 100 Hz applied to the differentiator. Also repeat the same for a square wave input. (10)
- 18. (a) (i) What is an Instrumentation Amplifier? Draw a system whose gain is controlled by an adjustable resistance. Name the circuit that is used to detect the peak value of the non-sinusoidal waveforms. (8)
 - (ii) Draw the circuit of a voltage to current converter if the load is floating and grounded. Is there any limitation on the size of the load when grounded? Discuss.

Or

- (b) (i) Derive the mathematical expression for the output voltage of Logarithmic amplifier using three op-amps only with neat diagram and its operation in a detailed manner.(10)
 - (ii) An 8-bit A/D converter accepts an input voltage signal of range 0 to 10 V. What is the minimum value of the input voltage required to generate a change of 1 LSB? What input voltage will generate all 1's at the A/D converter output? Also find the digital output for an input voltage of 4.8 V.

19. (a) Enumerate the desirable properties for a Voltage Controlled Oscillator (VCO). Draw the circuit diagram of a Voltage Controlled Oscillator (VCO) and discuss its operation in a detailed manner with proper mathematical equation. State assumptions and approximations, if any.

Or

- (b) Perform the closed-loop analysis of Phase Locked Loop (PLL) and derive the transfer function of PLL. Also derive the expressions for the lock-in and capture range of IC 565 Phase Locked Loop (PLL) with neat diagram. Calculate the output frequency, lock-range and capture-range of IC 565. Assume R1=10 Ω , C₁ = 0.01 μ F and C = 20 μ F. (16)
- 20. (a) How can the IC 723 voltage regulator be used to provide output voltages ranging from 2 V to 7 V? Draw the circuit diagram and discuss its operation in detail. Why is it called low voltage regulator? Also design a +15 V regulator using LM 723, with a current limiting value of 50 mA.

Or

- (b) (i) Mention the different configurations of a switching regulator. Draw any one basic block diagram and discuss its operation in detail.
 (8)
 - (ii) With a neat schematic diagram, describe a monolithic IC Audio power amplifier (LM 380). State its advantages over conventional power amplifiers. (8)

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