Bachelor of Instrumentation and Electronics Engineering, 2019
3rd year, 1st semester

ANALOG INTEGRATED CIRCUITS

Time : Three hours **Full Marks : 100**

ALL MODULES ARE COMPULSORY.

Module – I (10 Marks)

Q1(a). The circuit shown in Fig. P1(a) uses ideal op-Amps. Find out the current drawn from the voltage source V_{in} (=1 V). (5)

(b) Discuss the conditions which must be satisfied for op-Amp input terminals to be in "***virtual short***" condition. (5)

Module – II (10 Marks)

Q2.(a) In the circuit shown in Fig. P2(a), assume the op-Amp is ideal. The zener diode is also ideal with $V_Z = 2.5V$. At the input, one unit step voltage is applied, i.e. $V_i(t) = u(t)$ volts. At $t = 0$, both the capacitors are in totally discharged condition. Find out the time in milliseconds, at which the output voltage V_0 just crosses -10V. (5)

(b) For the circuit shown in Fig. P2(b), what is the value of V_0 ? (5)

Module – III (60 Marks)

(Answer any THREE from Q3, Q4, Q5 and Q6)

Q3. With the help of necessary circuit diagram and waveforms explain the operation of a unipolar triangle wave generator with a fundamental frequency of 100 hz and peak-peak to value of 2V. (15 + 5)

Q4. Realize the 5th order Butterworth polynomial in normalized s-domain. Use this polynomial to realize a 5th order Butterworth low-pass filter having 200Hz cutoff frequency and pass band gain 20. Show the final circuit diagram for the filter with all component values.

(5 + 15)

Q5. What is the main problem faced with simple diode based half-wave rectifier circuit ? Explain with proper waveforms. With the help of necessary circuit diagram and waveforms explain the operation of any precision full wave rectifier.

(5 + 15)

Q6. Explain how an analog multiplier can be realized using Log amplifiers, Anti-log amplifiers and operational amplifiers. Using analog multipliers and operational amplifiers realize the following function.

$$f(x,y,z) = \frac{2}{3}x^3 y^{\frac{1}{3}} + \sqrt{yz}$$

Assume that the inputs *x*, *y* and *z* are available as positive voltage sources.

(5 + 15)

Module – IV (20 Marks)

(Answer Either Q7 or Q8)

Q7. With the help of the relevant portion of the internal block diagram of IC-555, explain the operation of a 555-timer based square wave generator. Draw necessary circuit diagrams and waveforms. Hence realize a square wave of frequency 100 Hz and 50% Duty Cycle.

(15 + 5)

Q8.(a) Finite Slew Rate of an Op-Amp limits the amplitude of the output for a given frequency :- Explain.

(b) With the help of necessary circuit diagram and waveform, explain the operation of a 4-bit dual slope ADC.

(5 + 15)

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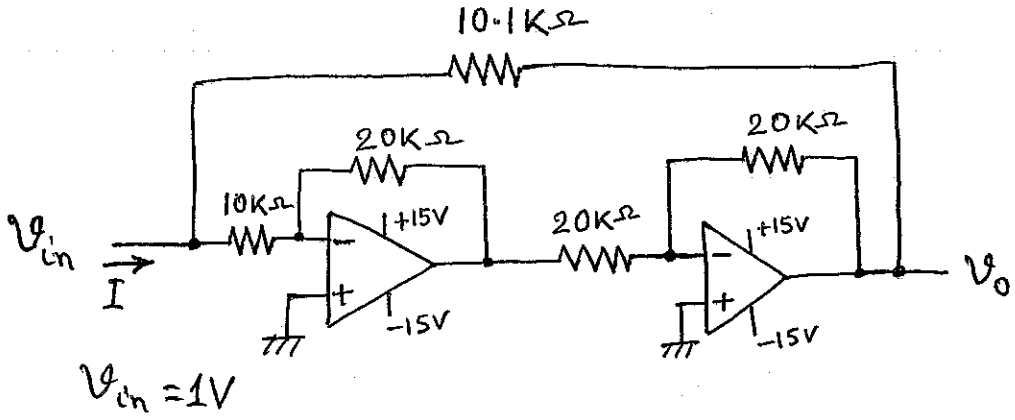

FIG. P1(a)

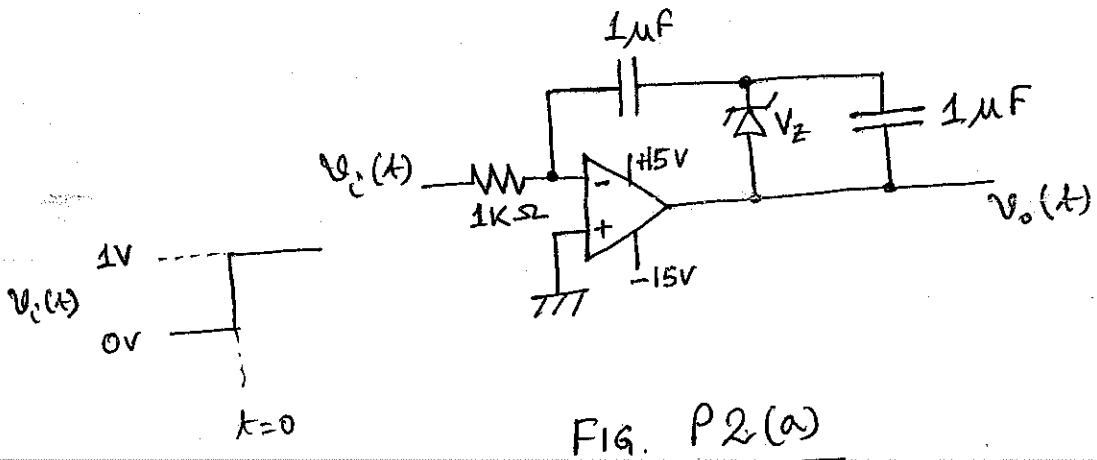

FIG. P2(a)

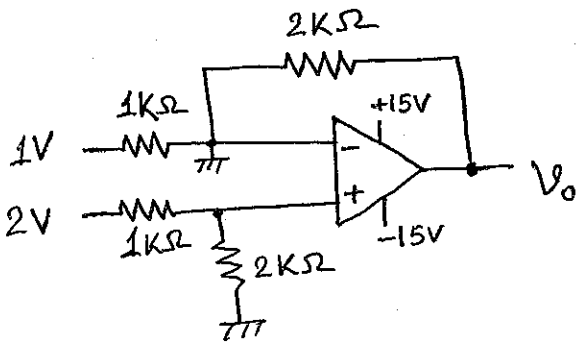

FIG. P2(b)