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DEPARTMENT OF ELECTRICAL & ELECTRONICS ENGINEERING,
ANNA UNIVERSITY, CHENNAI

B.E / B. Tech (Full Time) END SEMESTER EXAMINATIONS – APR/MAY 2024

EE 5303 Analog Electronics (Regulation 2019)

Time: 3 Hr. Answer ALL Questions Max. Marks 100

COURSE OUTCOMES:

CO1: Ability to understand the structure and underlying semi-conductor physics concepts.

CO2: Ability to design circuits employing electronic devices.

CO3: Analyze, comprehend and design of analog electronic circuits involving OP-AMPs

CO4: Analyze, comprehend and design of analog electronic circuits involving timer 555

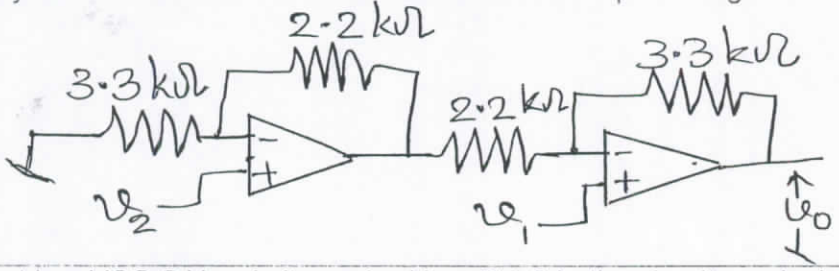
CO5: Analyze, comprehend and design of analog electronic circuits involving PLL,Volt.regulators & other special ICs.

PART- A (10 x 2 = 20 Marks)

Q.No	Quesions	Marks	CO
1.	Define output offset voltage of an OPAMP?	2	CO3
2.	Distinguish between drift current and diffusion current.	2	CO1
3.	Considering Silicon at T = 300 K doped with arsenic atoms at a concentration 7.7 x10^{15} cm^{-3}, evaluate the drift current density. Given that μ_n= 1350 cm^2/V-s and μ_p= 480 cm^2/V-s. The electric field intensity E = 77 V/cm.	2	CO1
4.	What is the role for the pin 5 of the 555 timer IC?	2	CO4
5.	What are the advantages of Successive Approximation type ADC, when compared to other types of ADCs?	2	CO5
6.	A 555 timer based astable multi-vibrator is operating with Ton = 25 msec and Toff = 15 msec. Now, if a diode is connected between pins 7 and 6 (with cathode of the diode to pin 6), evaluate the new frequency.	2	CO4
7.	For a transistor, relate the current gains α and β, after defining them	2	CO2
8.	Compare the stability factor of various biasing circuits applicable to a transistor?	2	CO2
9.	What are the features expected from a good instrumentation amplifier?	2	CO5
10.	What is a V-to-I converter? Give an application for the same.	2	CO3

PART- B (5 x 13 = 65 Marks)

Q.No	Questions	Marks	CO
11.	a) What is special about the region in between 'peak point' and 'valley point' of a UJT? What is UJT based relaxation oscillator? Derive an expression for its frequency of oscillations, after duly describing its operating principles. Design a UJT relaxation oscillator for a frequency of 500 Hz.	13	CO1
	OR		
	b) What do you understand from 'voltage divider bias' with reference to transistor biasing circuits? Considering a NPN transistor, design a voltage divider biasing circuit with v_{CE} = 5.0 V , v_E = 5.0 V and I_C = 2.5 mA. The supply voltage is 16 V. Assume that $v_{BE(ON)}$ = 0.7 V and that h_{FE} = 95. Also explain how this biasing circuit is better than other simpler types of biasing.	13	CO1
12.	a)For a transistorized differential amplifier , show that the output voltage	13	CO2

	v_O is proportional to the value of : $\tanh(v_d/2v_T)$, where v_d –is the differential input voltage and v_T – is the voltage equivalent of the ambient temperature.		
	OR		
	b) i) What is a Band Pass Filter based on Passive components? Obtain its characteristics. Describe how the 'gain-frequency characteristics' of a CE amplifier seems similar to this? ii) For an OPAMP based non-inverting amplifier, show that the gain is '$1+R_2/R_1$' by employing the concept of 'Voltage-Series feedback'? (5 + 8)	13	CO2
13.	a) After deriving the relevant expression, design a sine-wave generator for a frequency of 500 Hz. Make suitable assumptions for the design and derivation. You may consider either Wien bridge type or RC phase shift based oscillator.	13	CO5
	OR		
	b) Design a tri-angular waveform generator for a frequency of 500 Hz. Assume that the peak to peak output voltage required is 14 V and that the OPAMPs are powered from +/- 12 V d.c. supply..	13	CO5
14.	a) i) Design an OPAMP based 2nd order low-pass filter with cut-off frequency of 500 Hz. The required pass band gain is 20 dB. ii) What is a weighted resistor type DAC? How would you implement a 2-bit DAC of this type using only 10 KΩ resistors (using series or parallel combinations as required)? (8 + 5)	13	CO3
	OR		
	b) i)A single OPAMP based Differential amplifier circuit makes use of two number of 2 kΩ resistors and two number of 1 kΩ resistors. Draw the circuit diagram. One of the two 2 kΩ resistors is actually measured to be 2024 Ω. Assume that the OPAMP used is ideal and that other three resistors in the circuit to be exactly same as their nominal values. Evaluate the CMRR of this circuit ii) Identify the circuit shown below and evaluate the output voltage:  	13	CO3
15.	a) i) What is a VCO ? How is it required in a PLL? In the circuit employing VCO IC 566, when the control voltage is 80% of the supply voltage, what can you comment about the output frequency? ii) What is a 'function generator'? Give an example for a popularly available function generator IC? (9 + 4)	13	CO4
	OR		
	b) Draw the internal block diagram of a 555 timer? Design an astable multi-vibrator circuit employing 555 timer IC, for a frequency of 1 kHz, with Ton = 550 µsec. Derive the expressions used, starting from basics.	13	CO4

PART- C (1 x 15 = 15 Marks) (Q. No 16 is Compulsory)

Q.No	Question	Marks	CO
16.	i) Distinguish between JFET and MOSFET. ii) What is an emitter follower circuit? Compare it with a voltage follower circuit employing an OPAMP? iii) What are the 'golden rules' applicable to the analysis of OPAMP circuits employing negative feedback? Show that the output voltage of an OPAMP based integrator circuit, is proportional to the integral of the input voltage. iv) Draw the circuit diagram of a 2-bit R-2R ladder based DAC. Evaluate the output voltage for an input bit pattern of 10_2. (4 + 3 + 4 + 4)	15	CO1 CO2 CO3 CO5