2023

ANALOG CIRCUITS

Full Marks : 100

Time : Three hours

The figures in the margin indicate full marks for the questions.

*Answer **any five** questions.*

1.	a)	Why hybrid model is used for the analysis of BJT amplifier at low frequencies? Draw the hybrid model for CE transistor and derive the parameters.	2 +8=10
	b)	A CE amplifier is driven by a voltage source of internal resistance R_s = 800Ω and the load impedance of R_L=1000Ω. The h-parameters are h_{ie}=1k, h_{fe}=50, h_{oe} = 25μA/V and h_{re} = 2 x 10^{-4} . Calculate current gain, voltage gain, input impedance and output impedance using exact analysis and approximate analysis.	10
2.	a)	Explain high frequency equivalent circuit of BJT. Write about Collector junction capacitance and Emitter junction capacitance of hybrid-pi model.	6+4=10
	b)	Discuss Feedback topologies. An amplifier has a voltage gain of 400, f_1 = 50 Hz, f_2 = 200 kHz and a distortion of 10% without feedback. Determine the amplifier voltage gain, f_{1f}, f_{2f} and D_f when a negative feedback is applied with feedback ratio of 0.01.	4+6=10
3.	a)	What is an oscillators? Distinguish between an amplifier and an oscillators.	2+3=5
	b)	What is a tank circuit? What conditions must be satisfied to produce oscillations in an oscillator.	2+3=5
	c)	With neat diagram, explain Hartley Oscillator and derive the expression for frequency of oscillation.	10
4.	a)	Calculate the output voltage V_0 for the non-inverting OP-AMP summer circuit of the following figure.	6

	b)	What is the difference between active and passive filters? Why active filters are preferred to passive filters.	2+2=4
	c)	What is the principle of current mirror? Why is it called a current mirror? Explain the operation of a simple current mirror.	2+2+6=10
5.	a)	What are the limitations in weighted resistor type D/A converters and explain how this problem can solve in R-2R ladder type D/A converters. Explain the working of R-2R ladder DAC.	2+2+6=10
	b)	Draw the inverting and non-inverting amplifier circuits of an OP-AMP in closed loop configuration. Obtain expression for the closed loop gain in these circuits.	5+5=10
6.	a)	What is an operational amplifier? What are its characteristics?	1+4=5
	b)	Define the following parameters with respect to OP-AMP. (i) Input offset voltage (ii) CMRR (iii) Slew rate	2×3 = 6
	c)	Describe OP-AMP as low pass filter.	5
	d)	For an integrator circuit $v_1(t)=1 \sin \omega t$. If $R_1= 4K\Omega$ and $C= 2\mu F$. Find v_0 at $\omega t= \pi/2$, if $v_0(0)=0$ and $\omega= 1$ MHz.	4