Model Question Paper-1 with effect from 2019-20 (CBCS Scheme)

USN | | | | | | | | | |

Fourth Semester B.E. Degree Examination

Subject Title: Analog Circuits

TIME: 03 Hours **Max. Marks: 100**

Note: Answer any **FIVE** full questions, choosing at least **ONE** question from each **MODULE**.

		Module -1	***Bloom's Taxonomy Level**	**Marks**
Q.01	a	Explain the design constraints of a classical discrete-circuit biasing arrangement with circuit and relevant equations. How does R_E provide a negative feedback action to stabilize the bias current?	L2	**8**
	b	Considering the conceptual circuit of common emitter configuration, derive the expressions for g_m, r_Π, and r_e. Draw the hybrid –Π model of a transistor.	L1,L2	**8**
	c	A BJT having β=120 is biased at a DC collector current of 1 mA. Find the value of g_m, r_e , r_Π at the bias point .	L3	**4**
		OR		
Q.02	a	Design a fixed V_G bias circuit using Voltage divider arrangement to establish a DC drain current of 0.5mA. The MOSFET is specified to have V_t=1V, K_n'W/L=1mA/V^2 $\{\lambda = 0\}$. Use V_{DD} = 12V.Calculate the percentage change in the value of I_D obtained when the MOSFET is replaced with another MOSFET having the same k_n'W/L but V_t = 1.5V.	L3	**10**
	b	Explain the MOSFET biasing technique using a large drain-to-gate feedback resistance R_G. Design the drain-to-gate feedback biasing circuit to operate at a DC drain current of 0.5mA. Assume V_{DD} =5V, k_n'W/L=1mA/V^2, λ=0.	L3	**6**
	c	Draw and explain the small signal model of the MOSFET assuming $\lambda \neq 0$.	L1	**4**
		Module-2		
Q. 03	a	With a neat circuit diagram and ac equivalent circuit derive the expressions for R_{in}, A_{vo}, A_v and R_o for common source amplifier with an unbypassed source resistance.	L2	8
	b	Explain the internal capacitances of a MOSFET and hence draw the high frequency small signal model of MOSFET.	L1,L2	6
	c	For the n-channel MOSFET with t_{ox}=10nm, L=1µm, W=10µm, L_{OV}=0.05 µm, C_{sbo} = C_{dbo} = 10fF, V_O=0.6V, V_{SB}=1V and V_{DS}=2V. Calculate i)C_{OX} ii)C_{OV} iii)C_{gs} iv)C_{gd} v)C_{sb} vi)C_{db}	L3	6
		OR		
Q.04	a	Derive the expression for low frequency response of a common source amplifier.	L1,L2	8
	b	It is desired to design a phase-shift oscillator (Self biased JEFT amplifier) using a JEFT having g_m=5000µs, r_d =40k**Ω**, and feedback circuit resistance of R=10k**Ω**. Select the value of 'C' for oscillator operation at 1 kHz and R_D for a gain A=40 to ensure oscillator action.	L3	4

	c	With a neat diagram explain working of a crystal oscillator. Explain series and parallel resonance action with equivalent circuits and relevant expressions. A crystal has L=0.334H, C=0.065pF, C_M=1pF and R=5.5k**Ω.** Calculate its series and parallel resonant frequency.	L3	8
Module-3				
Q. 05	a	With a neat block diagram explain the working of a negative feedback amplifier. How is the overall gain affected in these amplifiers?	L1,L2	8
	b	Determine the voltage gain, input and output impedance with feedback for a voltage series feedback amplifier having A= -100, R_i=10k **Ω**, R_o=20k**Ω** for a feedback of i)β=1 and ii)β= -0.5	L3	8
	c	Draw the four basic negative-feedback topologies.	L1	4
OR				
Q. 06	a	Define power amplifiers and list the types of power amplifiers based on the location of Q point, conduction angle, efficiency and applications.	L1,L2	8
	b	Prove that the maximum conversion efficiency of a transformer coupled Class A amplifier is 50%.	L2	6
	c	Calculate the efficiency of a transformer coupled Class B amplifier for a supply of 12V and peak output voltage of 6V.	L3	2
	d	Explain in brief the working of a Class C power amplifier.		4
Module-4				
Q. 07	a	How does negative feedback affect the performances of an inverting amplifier using opamp? Derive the relevant expressions for Gain, input resistance and output resistance.	L2	8
	b	The opamp 714C is connected as an inverting amplifier with R_1=1k**Ω** and R_F=4.7k**Ω.** Compute the closed loop parameters: A_F, R_{IF}, R_{OF}, f_F. . Given A=400000, R_i=33M**Ω** and R_O=60**Ω**; supply voltages are ± 13V; Max output voltage swing = ± 13V, Unity gain bandwidth = 0.6MHz .	L3	6
	c	With a neat circuit diagram explain the opamp based inverting scaling amplifier and averaging circuit with relevant expressions for the output.	L1,L2	6
OR				
Q. 08	a	What is an instrumentation amplifier? What are its applications? With a neat circuit diagram explain an instrumentation amplifier using a transducer bridge.	L1,L2	10
	b	Draw the circuit and waveforms for an inverting Schmitt Trigger using opamp, with relevant expressions.	L1	4
	c	For an inverting Schmitt Trigger circuit R_1 = 15KΩ ; R_2 = 1KΩ and V_{in} = 10V_{p-pp} sine wave. The saturation voltages are ± 14V and V_{ref} = 2 V. i) Determine the threshold voltages V_{ut} and V_{lt}. ii) Find the value of Hysteresis voltage V_{hy}.	L3	6
Module-5				
Q. 09	a	Explain the working of a Successive Approximation type of ADC.	L2	8
	b	Explain with a neat circuit diagram, the working of a small signal half wave precision rectifier using an Opamp.	L2	4
	c	What is R-2R network type DAC? Explain with relevant expressions.	L1,L2	8
OR				
Q. 10	a	Explain the working of a second order high pass Butterworth filter with a neat circuit diagram and frequency response. Write the relevant design equations.	L1,L2	6
	b	Explain the operation of 555 timer as a Monostable multivibrator with relevant expressions.	L1,L2	8

	c	In an astable multivibrator $R_A = 2.2\ K\Omega$; $R_B = 3.9\ K\Omega$ and $C = 0.1\mu F$. Determine the positive pulse width T_c and negative pulse th T_d and free running frequency 'f_o'.	L3	6

*Bloom's Taxonomy Level: Indicate as L1, L2, L3, L4, etc. It is also desirable to indicate the COs and POs to be attained by every bit of questions.