CMR
INSTITUTE OF
TECHNOLOGY

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Internal Assesment Test - II

Sub:	Analog Circuits							Code:	18EC42
Date:	22/ 06 / 2021	Duration:	90 mins	Max Marks:	50	Sem:	4th	Branch:	ECE
Answer Any FIVE FULL Questions									

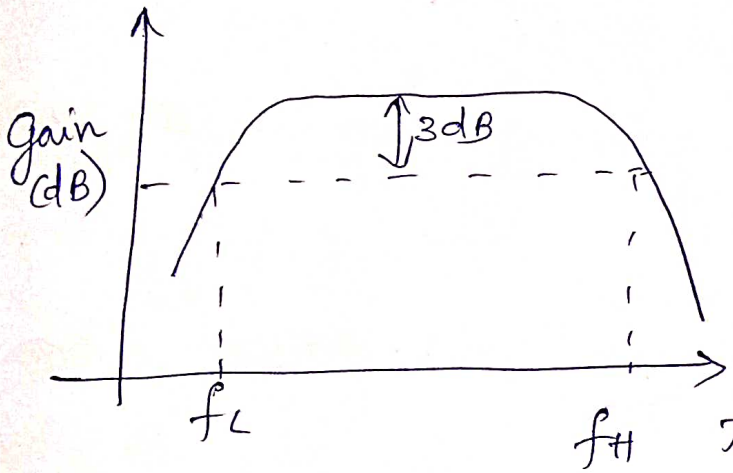
		Marks	OBE CO	OBE RBT
1.	Draw and explain the complete frequency response of a common source amplifier. Derive the expression for its lower cut-off frequency.	[10]	CO2	L3
2.	With the help of neat circuit diagram and small signal equivalent model explain the working of FET based RC Phase shift Oscillator. Also explain how three RC pair can be used to in the feedback to achieve 180 degree phase shift.	[10]	CO3	L3
3.	a) With a neat circuit diagram and ac equivalent circuit derive the expressions for R_{in}, A_{vo}, A_v for common source amplifier with source resistance.	[06]	CO2	L3
	b) Find the midband gain AM , and the upper 3-dB frequency fH of a CS amplifier fed with a signal source having an internal resistance Rsig = 100 kΩ. The amplifier has RG = 4.7MΩ, RD = RL = 15 kΩ, , gm=1mA/V, ro=150kΩ , Cgs=1pF and Cgd=0.4pF	[04]	CO2	L3
4.	Explain the internal capacitances of a MOSFET. For the n-channel MOSFET in saturation with tox=10nm, L=1µm, W=10µm, LOV=0.05 µm, Csbo = Cdbo = 10fF, VO=0.6V, VSB=1V and VDS=2V. Given dielectric used is SiO2. Calculate i)COX ii)COV iii)Cgs iv)Cgd v)Csb vi)Cdb	[10]	CO2	L3
5.	Show how noise reduction and bandwidth increment occurs with the application of negative feedback.	[10]	CO2	L3
6.	a) Draw the four basic negative-feedback topologies.	[04]	CO2	L2
	b) Draw and explain Series-Series feedback amplifier ideal structure. Also, derive Rif and Rof.	[06]	CO2	L2
7.	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, Cs=0.065pF, Cp=1pF. Calculate its series and parallel resonant frequency.	[10]	CO3	L3
8.	With a neat circuit diagram and ac equivalent circuit derive the expressions for Rin, Avo, Av , Ro and Gv for a source follower.	[10]	CO2	L3

Internal Assessment - II

Solution and Scheme of 18EC42

Analog circuits

1. Frequency response of Common source amplifier



Graph + explanation → 5M.

Expression for lower cutoff freq.
Derivation + explanation → 5M

} 10M.

$$\frac{V_o}{V_{sig}} = -\left[\frac{R_G}{R_G + R_{sig}}\right] g_m R_D /\!/ R_L \left(\frac{s}{s+\omega_{p1}}\right)\left(\frac{s}{s+\omega_{p2}}\right)\left(\frac{s}{s+\omega_p}\right)$$

2. FET based RC phase shift oscillator (10M).
circuit diagram (2M), equivalent model (2M)
explanation (2M)

3 RC pair in the feedback providing
180° phase shift (4M).

(3)

(a) $R_{in} = R_i = R_G$.

$A_{V_0} = \dfrac{-g_m R_D}{1+g_m R_S}$

$A_V = \dfrac{V_o}{V_i} = \dfrac{-g_m (R_D // R_L)}{1+g_m R_S}$ } expression 1+1+1 = 3M.

circuit diagram and eq. circuit 3M } 6M

(3) (b). $R_{sig} = 100K$. $R_G = 4.7M$. $R_D = R_L = 15K$

$g_m = 1mA/V$ $V_0 = 150K$ $C_{gs} = 1pF$ $C_{gd} = 0.4pF$.

$A_m = \dfrac{-R_G}{R_G + R_{sig}} g_m R_L' = -7 V/V$. (2M)

$f_H = \dfrac{1}{2\pi C_{in}(R_{sig} // R_G)} = 382kHz$ (2M)

4M.

(4) Internal Capacitance of MOSFET.

$C_{gs}, C_{gd}, C_{gb}, C_{sb}, C_{db}$ → All capacitors explanation with diagram (5M)

$C_{ox} = 3.45 fF/\mu m^2$, $C_{ov} = 1.72 ff$ $C_{gs} = 24.7 ff$

$C_{gd} = 1.72 ff$ $C_{sb} = 6.1 ff$ $C_{db} = 4.1 ff$ (5M)

(5) Noise reduction

(Block diagram) — 2M.

$$V_o = V_s \frac{A_1 A_2}{1 + A_1 A_2 \beta} + V_n \frac{A_1}{1 + A_1 A_2 \beta}$$

} explanation + equation (3M)

$$\frac{S}{N} = \frac{V_s}{V_n} A_2 .$$

BW extension (5M)

$$A_f(s) = \frac{\frac{A_m}{1 + A_m \beta}}{1 + \frac{s}{\omega_H (1 + A_m \beta)}} = \frac{A_{mf}}{1 + \frac{s}{\omega_{Hf}}} .$$

(6)(a) Four basic topology (block diagram) 4M.

(b) Series-series feedback. explanation and gain (2M)

Rif (2m)

Rof (2m)

} 6m.

(7) · Crystal Oscillator – structure, equivalent circuit (2M).

Explanation – Series and parallel Resonance action + expressions (3 M)

Numerical problem – 5M.

(8) · $R_{in} = R_G$.

$$A_V = \frac{R_L // r_o}{R_L // r_o + \frac{1}{g_m}} \approx \frac{R_L}{R_L + \frac{1}{g_m}}$$ when $r_o >> R_L$

$$A_{VO} = \frac{r_o}{r_o + \frac{1}{g_m}} \approx 1.$$

$$G_V = \frac{R_a}{R_a + R_{sig}} \frac{R_L // r_o}{(R_L // r_o) + \frac{1}{g_m}}$$

7M.

$$R_{out} = \frac{1}{g_m} // r_o \approx \frac{1}{g_m}.$$

Circuit diagram and equivalent circuit 3M.

10M.