CBCS SCHEME

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18EC42

Fourth Semester B.E. Degree Examination, June/July 2024
Analog Circuits

Time: 3 hrs. Max. Marks: 100

Note: Answer any FIVE full questions, choosing ONE full question from each module.

Module-1

1 a. Explain the design concept of common emitter collector to Base feedback resistor biasing circuit and explain how collector to base feedback resistor provides a negative feedback in the circuit. **(07 Marks)**

b. Considering the conceptual circuit of common source MOSFET amplifier, derive the expression for transconductance g_m and voltage gain A_V. **(08 Marks)**

c. For common emitter voltage divider circuit having $\beta = 100$, $R_1 = 10\ K\Omega$, $R_2 = 5\ K\Omega$, $R_C = 1\ K\Omega$ and $R_E = 500\ \Omega$ is provided with DC biasing voltage $V_{CC} = 10$ V, Calculate V_{CE} and I_C. **(05 Marks)**

OR

2 a. Derive an expression for small signal collector current, transconductance g_m and voltage gain A_V in BJT, when small signal V_{bc} is applied between base and emitter. **(10 Marks)**

b. Design voltage divider bias circuit using MOSFET to establish $I_D = 0.5$ mA and MOSFET parameter are $V_t = 1$ V and $K_n'\left(\frac{\omega}{L}\right) = 0.5\ mA/V^2$. Assume $V_{DD} = 15$ V. **(10 Marks)**

Module-2

3 a. Explain Three basic configurations of MOSFET amplifier and derive expression for characteristic parameter of amplifiers. **(08 Marks)**

b. Briefly explain the Barkhausen criteria for oscillation. **(04 Marks)**

c. For an n-channel MOSFET with $t_{ox} = 10$ nm, $L = 1\ \mu m$, $W = 10\ \mu m$, $L_{ov} = 0.05\ \mu m$, $C_{Sbo} = C_{dbo} = 10$ fF, $V_O = 0.6$ V, $V_{SB} = 1$ V, $V_{DS} = 2$ V. Calculate the following capacitance when the transistor is operating in saturation,
(i) C_{OX} (ii) C_{OV} (iii) C_{gs} (iv) C_{gd} (v) C_{sb} and C_{db}.
Consider $\epsilon_{ox} = 3.45 \times 10^{-11}$ **(08 Marks)**

OR

4 a. Explain the working of RC phase shift oscillator and show how RC network provides 180° of phase shift. **(08 Marks)**

b. In a transistor Calpitts oscillator $C_1 = 1$ nF and $C_2 = 1000$ nF. Find the value of L for a frequency of 100 kHz. **(04 Marks)**

c. Explain the High frequency response of common source MOSFET amplifier with its equivalent circuit. **(08 Marks)**

Module-3

5 a. Explain the effect of negative feedback on input and output resistance of voltage series feedback amplifier. **(10 Marks)**

b. Explain transformer coupled Class A power amplifier and show that the maximum efficiency of transformer coupled Class A power amplifier is 50%. **(10 Marks)**

OR

6 a. Draw the block diagram of four types of feedback topologies and compare them with respect to input and output resistance. **(10 Marks)**

b. Compare Class B pushpull and complementary symmetry power amplifiers. **(04 Marks)**

c. In a Class B push pull amplifier operating with $V_{CC} = 25V$ provides a 22 V peak signal to an 8 Ω load. Find

(i) Peak load current (ii) dc current drawn from the supply (iii) input power

(iv) Output current efficiency (v) power dissipation **(06 Marks)**

Module-4

7 a. State the ideal op-amp characteristics. **(06 Marks)**

b. Design a linear combination circuit using op-amp to obtain output $V_0 = -2V_1-8V_2-V_3$ with $R_{fn} \geq 20\,k\Omega$ at all the inputs and all the resistances $\leq 200\,k\Omega$ **(04 Marks)**

c. Draw the circuit of 3 op-amp instrumentation amplifier and derive the expression for its output voltage. **(10 Marks)**

OR

8 a. Explain the working of voltage follower using op-amp and show that its gain is unity. State its advantages. **(06 Marks)**

b. Explain the working of zero crossing detectors. **(06 Marks)**

c. Design an inverting Schmitt trigger to have trigger voltages of $\pm 4V$ using op-amp 741 with supply of $\pm 15V$. Consider $I_{B(max)} = 500\,nA$. **(08 Marks)**

Module-5

9 a. With neat circuit diagram, explain the operation of R-2R D/A converter. **(10 Marks)**

b. Explain the working of pulse width modulation circuit using 555 IC. **(06 Marks)**

c. Design a low pass filter using op-amp at a cut off frequency of 1 kHz with pass gain of 2 and choose C = 0.01 μF **(04 Marks)**

OR

10 a. Explain with neat circuit diagram the working of positive precision Half Wave Rectifier. **(06 Marks)**

b. Design a monostable 555 timer circuit to produce an output pulse of 10 sec wide and draw the circuit diagram. Choose C = 100 μF. **(04 Marks)**

c. Draw the circuit of second order low pass filter and explain its operation. **(10 Marks)**

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