Code : 041404

2013

ANALOG ELECTRONICS

Time : 3 hours | *Full Marks* : 70

Instructions :

(i) The marks are indicated in the right-hand margin.

*(ii) There are **NINE** questions in this paper.*

*(iii) Attempt **FIVE** questions in all.*

(iv) Question No. 1 is compulsory.

1. Answer any *seven* of the following : 2×7=14

   (a) What are the salient features of hybrid parameters?

   (b) A BJT has $C_\mu = 1$ pF. If $g_m = 50$ mA/V, calculate f_T of a common-emitter amplifier using this BJT.

   (c) What is inter-modulation distortion in amplifier?

   (d) Write down the transfer function of a simple RC low-pass circuit.

(e) Under what condition, output of an amplifier preserves the form of input signal?

(f) What are tuned amplifiers?

(g) Explain how the conduction angle in class C amplifier is maintained.

(h) Why are power transistors provided with heat sinks?

(i) Define Q factor of a resonant circuit.

(j) What are the constituent parts of an oscillator?

2. (a) Draw the equivalent circuit for the CE and CC configurations subject to the restriction that input is open circuited. Show that output impedances of the two circuits are identical. 8

(b) A transistor is used in CB amplifier with $R_L = 150$ kohm and $R_S = 10$ ohm. The h-parameters are $h_{ib} = 40$ ohm, $h_{rb} = 3 \times 10^{-4}$, $h_{ob} = 1\mu$ mho, $h_{fb} = 0.98$. Calculate A_i, Z_i, A_v.

3. (a) Draw and explain the small-signal high-frequency CE model of a transistor. 6

(b) Following low frequency parameters are known for a given transistor at $I_C = 10$ mA, $V_{CE} = 10$ V and at room temperature :

$h_{ie} = 500$ ohm, $h_{re} = 10^{-4}$

$h_{oe} = 4 \times 10^{-5}$ A/V, $h_{fe} = 100$

At some operating point, $f_T = 50$ MHz and $C_{ob} = 3$ pF, compute the values of all the hybrid-π parameters. 8

4. (a) Derive the expression for the CE short-circuit current gain as a function of frequency. 8

(b) What are multistage amplifiers? Why do we need these amplifiers? Derive the equation of overall gain of a multistage amplifier in terms of the gain of individual stage in dB. 6

5. (a) Sketch the response of an amplifier to a low-frequency square wave. Define the term tilt. How is the tilt related with the low 3 dB frequency f_L? 7

(b) Three identical cascaded stages have an overall upper 3 dB frequency of 20 kHz and a lower 3 dB frequency of 20 Hz. What are f_L and f_H of each stage? Assume non-interacting stages. 7

6. (a) What are the advantages of push-pull arrangement of amplifier? Draw its circuit and explain the working. 6

(b) In a class A amplifier, $V_{CE\,min} = 5$ V, $V_{CE\,max} = 25$ V. Find the overall efficiency for (i) series fed load and (ii) transformer coupled load. 8

7. (a) A tank circuit has a capacitor 100 pF and an inductor 100 μH. The resistance of the inductor is 5Ω. Determine the resonant frequency, impedance at resonance, Q factor and bandwidth of this tank circuit. 7

(b) Explain the principle and describe the working of a shunt-fed Hartley oscillator. 7

8. (a) A class A power amplifier uses a transformer as a coupling device. The transformer has a turn ratio of 10 and the secondary load is 10Ω. If the zero signal collector current is 100 mA, find the maximum power output. 7

(b) Draw the Wien bridge oscillator circuit and derive the expression for frequency of oscillation. 7

9. Write short notes on any two of the following : 7×2=14

(a) Harmonic distortion in amplifier

(b) Incremental model of FET

(c) Ideal voltage and trans-resistance amplifiers