Code : 041404

B.Tech 4th Semester Examination, 2017

Analog Electronics

Time : 3 hours *Full Marks : 70*

Instructions :

(i) There are Nine Questions in this Paper.

(ii) Attempt Five questions in all.

(iii) Question No. 1 is Compulsory.

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

1. Answer any seven (7) questions out of ten (10). 2×7=14

(i) The maximum efficiency of Class B amplifier is:

(a) 90%

(b) 78.5%

(c) 98%

(d) 10%

(ii) Which relationship between the h-parameters is WRONG?

(a) $h_{ee} = h_{oc}$

(b) $h_{rc} = 1$

(c) $h_{ic} = h_{ie}$

(d) $h_{oc} = 1/h_{oe}$

(iii) Which of the following is the correct values of hybrid-π model parameters (C_c & C_e) at $IC = 1.3$ mA:

P.T.O.

(a) 3 pF & 100 pF
(b) 300 pF & 1 pF
(c) 30 pF & 10 pF
(d) 0.03 pF & 1000 pF

(iv) Which of the following distortion in amplifier result from the production of new frequencies in the output which are not present in the input signal?
(a) Frequency distortion
(b) Phase-shift distortion
(c) Non-linear distortion
(d) None of these

(v) The input impedance (Z_i) and the output impedance (Z_o) of an ideal trans-conductance (voltage controlled current source) amplifier are:
(a) $Z_i = 0,\ Z_o = 0$
(b) $Z_i = 0,\ Z_o = \infty$
(c) $Z_i = \infty,\ Z_o = 0$
(d) $Z_i = \infty,\ Z_o = \infty$.

(vi) Oscillators are working on the principle of:
(a) Positive feedback
(b) Negative feedback
(c) Any of positive or negative feedback
(d) None of these

(vii) Impact of current shunt feedback topology is:
(a) Both input and output resistances decreases
(b) Both input and output resistances increases
(c) Input resistance increases, but output resistance decreases
(d) Input resistance decreases, but output resistance increases

(viii) Cascading of non-interacting amplifier stages usually results in:
(a) Increase in overall bandwidth
(b) Decrease in overall bandwidth
(c) Decrease in overall gain
(d) None of these

(ix) For the feedback amplifier to be stable, its poles must all be in the:
(a) Left half of the s-plane
(b) Right half of the s-plane
(c) Any where in the s-plane
(d) None of these

(x) For the approximate analysis of low-frequency transistor circuits, two of the four h-parameters (h_{re} and h_{fe}) are sufficient under which of the following condition.
(a) $h_{oe} R_L < 0.1$

(b) $h_{re} R_L > 0.1$

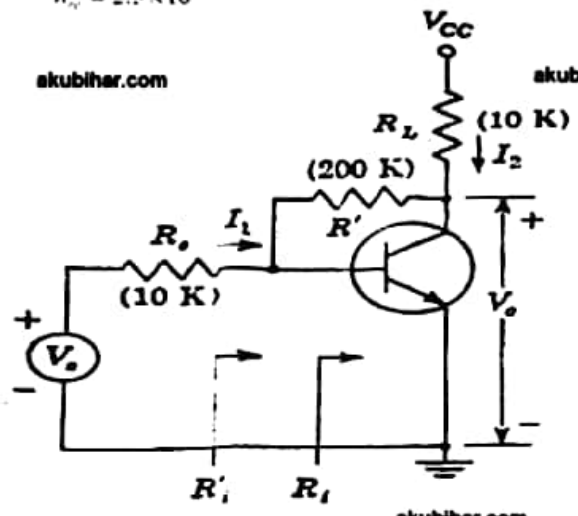
(c) $h_{oe} = h_{re}$

(d) All of these

Answer any Four (4) from the remaining Eight (8) Questions.

2. (a) Determine the parameter h_{re} in terms of the CB h-parameters. 6

(b) For the amplifier shown in the figure below, Calculate R_i, R_i', A_v, Avs, $A_i = \frac{I_2}{I_1}$. Assume $h_{fe} = 50$, $h_{ie} = 1100\,\Omega$, $h_{oe} = 24 \times 10^{-6}\,A/V$, and $h_{re} = 2.5 \times 10^{-4}$



3. (a) With the help of suitable figures(s), discuss trans-resistance amplifier. Determine the expression for its input current, output voltage, and loaded trans-resistance gain. 8

(b) Draw hybrid-π model for a transistor in the CE configuration. Discuss the circuit components. 6

4. (a) Consider an emitter follower. Neglect h_{re} and show that as $R_e \to \infty$

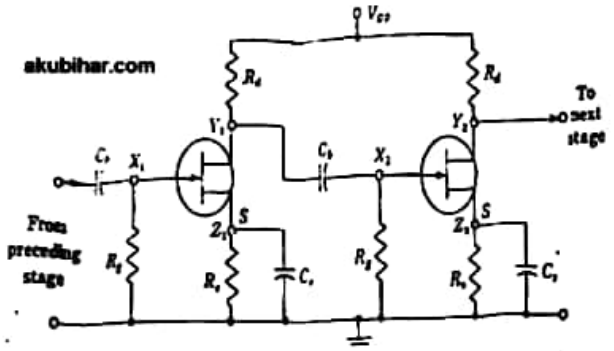
(i) $R_i \to h_{ie} + (1 + h_{fe})/h_{oe} \approx 1/h_{ob}$

(ii) $1 - AV \approx h_{ie} h_{oe} / (1 + h_{fe})$

Evaluate Av. Assume $h_{fe} = 50$, $h_{ie} = 1100\,\Omega$, $h_{oe} = 24 \times 10^{-6}\,A/V$, and $h_{re} = 2.5 \times 10^{-4}$. 7

(b) Describe the Rise time and Tilt (Sag). Find the *rise time* for an amplifier with 1 MHz bandpass. Also, find the per cent *tilt*, if we wish to pass a 50-Hz square wave with lower 3-dB frequency of 1 or 2 Hz. 7

5. (a) A two-stage FET RC-coupled amplifier has the following parameters: $g_m = 10$ mA/V, $r_d = 5.5\ K\Omega$, $R_d = 10\ K\Omega$ and $R_g = 0.5\ M\Omega$ for each stage. Assume C_c in the figure below to be arbitrarily large. *(i)* What must be the value of C_c in order that the frequency characteristics of each stage be flat within 1 dB down to 10 Hz? *(ii)* repeat part *(i)* if the overall gain of both stages is to be down 1 dB at 10 Hz? *(iii)* What is the overall mid-band voltage gain?



(b) Sketch the circuit of a push-pull class B transistor amplifier in the common-collector configuration without an output transformer. 2

6. (a) Derive the expression for the CE short-circuit current gain A_i as a function of frequency. 7

(b) Given the following transistor measurements made at $I_C = 5mA, V_{CE} = 10V$, and at room temperature; $h_{fe} = 100$, $h_{ie} = 600$ ohms, $[A_{ie}] = 10$ at 10 MHz, $C_c = 3$ pF. Find $f_\beta, f_T, C_e, r_{bc}, r_b, b$. The symbols used have their usual meaning.

7. (a) Define and discuss the positive feedback. Also give two *Barkhausen conditions* required in order for sinusoidal oscillations to be sustained. 7

(b) Discuss the classification of amplifiers according to method of operations. 7

8. (a) With the help of suitable diagram(s), describe the Wien bridge oscillator. 7

(b) An amplifier with an open-loop voltage gain of 1000 delivers 10 W of output power at 10 per cent second-harmonic distortion when the input signal is 10 mV. If 40-dB negative-series feedback is applied and the output power is to remain at 10 W, determine (i) the required input signal, (ii) the per cent harmonic distortion. 7

9. (a) Design a phase-shift oscillator to operate at a frequency of 5 kHz. Use a MOSFET with $\mu = 55$ and $r_d = 5.5K$. The phase-shift network is not to load down the amplifier. (i) Find the minimum value of the drain-circuit resistance R_d for which the circuit will oscillate, (ii) Find the product RC, (iii) Choose a reasonable value for R, and find C. 9

(b) With the help of suitable diagram(s), discuss the Tuned amplifier. 5

•••