Bengal Engineering & Science University, Shibpur

BE 3rd semester (ETC) Final Examination 2013

Analog Electronics(ET 304)

Group : A

Answer any three questions from this group

2 marks are reserved for neatness in this group

1. Explain the term 'operating point' of a transistor. What are the factors that affect the bias stability of a transistor?
   Find the Q-point of a self bias transistor circuit with the following specifications:

   Vcc= 22.5V, RL = 5.6KΩ, Re= 1KΩ, R1= 90KΩ, R2 = 10KΩ, VBE = 0.7V and β = 55. Assume IB >> ICO.

   [2+2+7]

2. A CE amplifier uses a transistor with hie = 1KΩ, hfe = 100, and hoe = 25 μA/V. The load resistance is 5KΩ. Find the current amplification and the overall voltage and power gains for a load resistance of 1KΩ. Derive all the equations which are required to solve this problem.

   [3+8]

3. Make a comparison between a class A, B and class AB amplifiers. Draw the circuit of a class A power amplifier and explain its operation. Find out its efficiency.

   [2+2+2+5]

4. Explain with a neat circuit the operation of a class B push-pull amplifier and mention its drawback and how it can overcome in a class B complementary symmetry push-pull amplifier. What is cross-over distortion?

   [4+2+2+3]

5. Draw a circuit of a two stage R-C coupled amplifier and draw its gain frequency response. Using h-parameter explain why gain remains constant over mid-frequency range of operation and that falls at low frequency range for operation.

   [2+1+8]

GROUP B

Answer any two questions

One mark is reserved for neatness

1a) Draw the circuit for a current shunt feedback and apply the feedback rules to obtain the current gain input impedance and output impedance.

Does the current gain obtained by this method match the value obtained without applying any feedback rule? Explain.

b) For the circuit shown in Fig.1, prove that

$$A_{vf} = \frac{V_0}{V_s} = -\frac{R'}{R}\frac{1}{1+\frac{R'}{R_m}\left(\frac{R_i+R'}{R'}+\frac{R_i}{R}\right)}$$

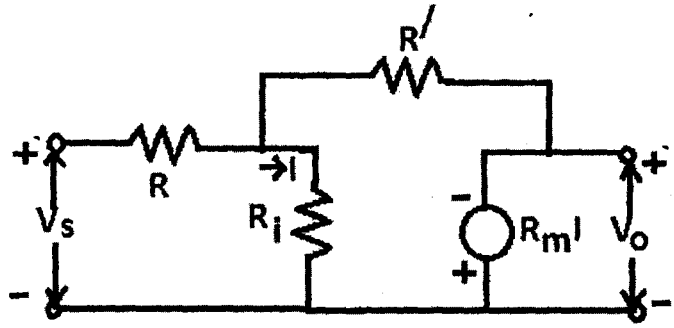

Fig.1

(12+5)

2a) A single stage RC coupled amplifier with a midband voltage gain of 1000 is made into a feedback amplifier by feeding 10% of its output voltage in series with the input opposing. Assume that the amplifier gain without feedback may be approximated by $A_L=A_0/(1-j(f_L/f))$ at low frequencies and by $A_H=A_0/(1+j(f/f_H))$ at high frequencies, find the following:

i) If f_L=20Hz and f_H=50kHz for the amplifier without feedback, what are the corresponding values after feedback has been added?

ii) What is the ratio of half-power frequencies with feedback to those without feedback?

b) i) In the circuit shown in Fig.2, show that the voltage gain is given by $A_{vf} = \frac{V_o}{V_i} \sim \frac{-h_{fe}R_L}{R_i-h_{ie}-h_{fe}R_s}$,

assuming h_{fe}>>1 and neglecting h_{re} and h_{oe}.

ii) If the relative change dA_{vf}/A_{vf} of the voltage gain A_{vf} must not exceed a specified value μ_f due to variations of h_{fe}, show that the minimum required value of the emitter resistor R_e is given by equation 1:

$$R_e = \frac{R_s - h_{ie}}{h_{fe}} \left(\frac{dh_{fe}/h_{fe}}{\mu_f} - 1 \right) \qquad (1)$$

c) Show that the effect of harmonic distortion in an amplifier is reduced in the presence of negative feedback.

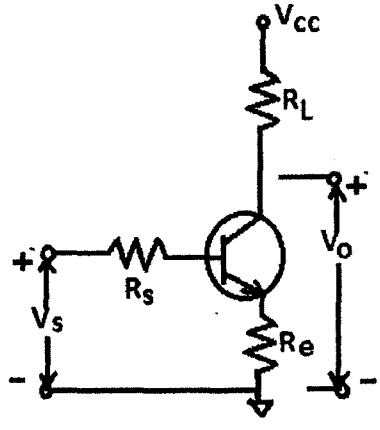

Fig.2

(6+8+3)

3a) Is Barkhausen criteria sufficient to build up sinusoidal oscillation? Explain with an example.

b) Draw the circuit of a phase shift oscillator and derive the frequency of oscillation. Also obtain the condition necessary to build up oscillation. Where the transistor should be biased to prevent the oscillator from saturating?

c) What is crystal oscillator? Draw it's equivalent circuit and derive the dependence of reactance with frequency.

(4+8+5)

4a) What is the advantage of differential amplifier over a single stage amplifier? Derive the expressions of differential and common mode gain, stating all the assumptions.

b) If the g_m of one transistor is twice of the other, derive the expression of common mode gain.

c) What are the ideal characteristics of a current source? Realize a constant current source using BJTs and obtain the expression of the current in terms of the passive components and h-parameters. (7+4+6)