Electronic Circuit Analysis

Important Questions

UNIT – I

**Multistage Amplifiers:** Classification of Amplifiers, Distortion in amplifiers, Different coupling schemes used in amplifiers, Frequency response and Analysis of multistage amplifiers, Cascade RC Coupled amplifiers, Cascode amplifier, Darlington pair.

**Transistor at High Frequency:** Hybrid - π model of Common Emitter transistor model, $f_\alpha$, $f_\beta$ and unity gain bandwidth, Gain-bandwidth product.

2 or 3 Marks Questions:

1. Compare coupling amplifiers?
2. Why band width reduces with cascading of amplifiers.
3. Classify Amplifiers.
4. What do you mean by distortion? Write the different types of distortions.
5. Write different coupling schemes used in amplifier?
6. Write the difference between cascade and cascode amplifiers?
7. What is Darlington pair? What is its significance?
8. Define $f_\beta$, $f_\alpha$ and $f_T$?
9. Draw the hybrid π model for a transistor CE configuration.

5 Marks Questions:

1. Draw the Darlington circuit and derive the expression for the overall current gain, voltage gain, input impedance and output impedance.
2. With the help of a neat circuit diagram describe the working of a cascade amplifier (two stage RC coupled CE-CE amplifier.
3. Derive the expressions for overall voltage gain, current gain, input impedance and output impedance when two identical amplifier stages are cascaded.
4. With the help of a neat circuit diagram describe the analysis of cascode amplifier.

5. Draw the hybrid-π model of common emitter configuration and describe each component in the π-model. (or) What is Giacolletto model of a transistor? Discuss about various parameters in the model.
6. Derive the equation for voltage gain and bandwidth product for CE amplifier.
7. Draw the equivalent diagram of a single stage CE amplifier at high frequencies. Derive the expression for gain under short circuited load conditions.
8. Derive the CE short circuit current gain at high frequency.
9. Define $f_\beta$ and $f_T$ and also derive the relation between them.
10. Write the relation between low frequency h-parameters and high frequency π parameters.

Simple Problems:

1. For a cascaded CE-CC configuration, the h-parameters are given as hie=1kΩ, hre=$10^{-4}$, hfe=50, hoe=$10^{-4}$ A/V, hic=1kΩ, hrc=1, hfc= -51, hoc=$10^{-4}$ A/V. Find the input and output impedances of the cascaded configuration
2. If four identical amplifiers are cascaded each having $f_H$=100KHz, determine the overall upper 3dB frequency $f_H$. Assume non interacting stages.
3. If the overall lower and higher cut-off frequencies of a two identical amplifier cascade are 600Hz and 18KHz respectively, compute the values of the individual cutoff frequencies of both the amplifier stages.
4. In a BJT configuration the following specifications were observed. $I_c$=1mA, $h_{ie}$=3KΩ, $h_{fe}$=100, $c_{b'e}$=18pF, $c_{b'c}$=2pF. Determine $g_m$, $r_{b'e}$, $r_{b'b}$, $f_\beta$ where $R_L$=1KΩ.
5. A BJT has $h_{ie}$=6KΩ and $h_{fe}$=224 at $I_c$=1mA with $f_T$=80MHz and $c_{b'c}$=12pF. Determine $g_m$, $r_{b'e}$, $r_{b'b}$ and $c_{b'e}$ at room temperature.
6. A BJT has $g_m$=38milli mhos, $r_{b'e}$=5.9KΩ, $h_{ie}$=6KΩ, $r_{b'b}$=100Ω, $c_{b'c}$=12pF, $c_{b'e}$=63pF and $h_{fe}$=224 at 1KHz. Calculate α and β cutoff frequencies and $f_T$.
7. Amplifier parameters are $g_m$=0.2A/V, $r_{b'b}$=100Ω, $r_{b'e}$=1KΩ, Ce=200pF, Cc=4pF, $r_{ce}$=80KΩ. Assume coupling and bypass capacitors to be perfect short at mid and

high frequencies. Draw Hybrid-π equivalent circuit of the amplifier and calculate (i) Mid frequency voltage gain $V_0/V_s$ (ii) $f_\beta$ (iii) $f_T$.

8. Given the following transistor measurement made at Ic = 5 mA, Vce = 10V and at room temperature: hfe = 100, hie = 600 ohm, Ai = 10 at 10MHz, Cc= 3 pF. Calculate fβ, fT, Ce, rb'e and rbb'.

UNIT – II

**Feedback Amplifiers:** Concepts of feedback – Classification of feedback amplifiers – General characteristics of Negative feedback amplifiers – Effect of Feedback on Amplifier characteristics – Voltage series, Voltage shunt, Current series and Current shunt Feedback configurations – Simple problems.

## 2 or 3 Marks Questions:

1. Define negative feedback?
2. What are the general characteristics of negative feedback amplifiers?
3. Compare feedback configurations with their input and output resistances.
4. Define sensitivity and De-sensitivity of a negative feedback amplifier.
5. Write the advantages and disadvantages of negative feedback?

## 5 Marks Questions:

1. Explain the principle of negative feedback in amplifiers. Show quantitatively the effect of negative feedback on (i) Gain (ii) Stability (iii) Noise (iv) Distortion (v) Bandwidth
2. Derivations of input & output impedance of Voltage series, shunt, current series and shunt feedback amplifiers.
3. Give the block diagram of a general feedback amplifier. State the function of each block.

## Simple Problems:

1. An amplifier has a value of $R_{in}$ = 4.2kΩ, $A_v$=220 and β=0.01, determine the value of input resistance with feedback.
2. The gain of an amplifier is decreased to 1000 with negative feedback from its gain of 5000. Calculate the feedback factor and amount of negative feedback in dB.
3. An amplifier has a mid band gain of 125 and bandwidth of 250 kHz. If 4% negative feedback is introduced and what new bandwidth and gain.

UNIT - III

**Oscillators:** Condition for Oscillations, RC type Oscillators-RC phase shift and Wien-bridge Oscillators, LC type Oscillators –Generalized analysis of LC Oscillators, Hartley and Colpitts Oscillators, Frequency and amplitude stability of Oscillators, Crystal Oscillator.

2 or 3 Marks Questions:

1. Define positive feedback?
2. Why RC Phase shift oscillators are not used at high frequencies?
3. Write the conditions for oscillations?
4. Why LC oscillators are not used at low frequencies?
5. Compare Frequency stability of crystal oscillator, RC and LC oscillators.
6. State Barkhausen criterion.

5 Marks Questions:

1. Derive the generalized expression for LC oscillators?
2. Draw the circuit diagram of a Wien bridge oscillator and derive the expression for frequency of oscillator.
3. Draw the circuit diagram of Colpitts oscillator and derive the expression for frequency of oscillator.

4. Draw the circuit diagram of Hartley oscillator and derive the expression for frequency of oscillator.
5. Derive the expression for frequency of oscillation of RC phase-shift oscillator and explain its operation with neat circuit diagram.
6. What is the equivalent circuit of a crystal? Derive the expressions for series and parallel resonances.

Simple Problems:

1. A crystal oscillator has the following parameters: L=0.33H, C=0.065pF, C=1.0pF and R=5.5kΩ. i) Find the series resonant frequency. ii) Find the Q of the crystal.
2. In the Hartley Oscillator $L_2$=0.4mH & C=0.004µF. If the frequency of oscillator is 120KHz, find the value of $L_1$ (neglect the M).
3. A transistorized Hartley Oscillator, the two inductances are 2mH and 20µH while the frequency is to be changed from 950KHz to 2050KHz. Calculate the range over which the capacitor is to be varied.
4. In Colpitts oscillator $C_1$=0.2µF & $C_2$=0.02µF & the frequency of oscillator is 10KHz, find the value of inductor and also find the required gain for oscillation.

UNIT - IV

**Large Signal Amplifiers:** Class A Power Amplifier- Series fed and Transformer coupled , Conversion Efficiency, Class B Power Amplifier- Push Pull and Complimentary Symmetry configurations, Conversion Efficiency, Principle of operation of Class AB and Class –C Amplifiers.

**Tuned Amplifiers:** Introduction, single Tuned Amplifiers – Q-factor, frequency response of tuned amplifiers, Concept of stagger tuning and synchronous tuning.

2 or 3 Marks Questions:

1. Classify power amplifiers.
2. What are the advantages of push pull power amplifiers.

3. What is cross over distortion? Explain how to eliminate it?
4. Define Q factor.
5. Give the classification of tuned amplifiers
6. What is a tuned amplifier?
7. What are the advantages and disadvantages of series fed and transformer coupled class-A power amplifier?
8. Differentiate between push-pull and complementary-symmetry configurations of a class B power amplifier.
9. Explain the reasons for crossover distortion in class-B power amplifiers and suggest a suitable circuit for its minimization.
10. Define synchronous tuning?

5 Marks Questions:

1. Describe the operation of Class B Push pull amplifier.
2. Derive the expression for maximum conversion efficiency for a simple series fed Class A power amplifier.
3. Derive the expression for the efficiency of a Transformer Coupled Class-A Power Amplifier.
4. Derive the expression for the efficiency of a Push Pull Class-B Power Amplifier.
5. With the help of a neat circuit diagram, explain the operation of a complementary symmetry configured class B power amplifier.
6. Write the principle of operation of class-C amplifier.
7. Draw the equivalent circuit of singled tuned amplifier and derive the expression for gain and bandwidth at resonance.
8. Explain the frequency response of single tuned amplifiers.
9. Explain Concept of stagger tuning and synchronous tuning.

UNIT – V

**Multivibrators**: Analysis and Design of Bistable, Monostable, Astable Multivibrators and Schmitt trigger using Transistors.

**Time Base Generators:** General features of a Time base Signal, Methods of Generating Time Base Waveform, concepts of Transistor Miller and Bootstrap Time Base Generator, Methods of Linearity improvement.

## 2 or 3 Marks Questions:

1. Define Multivibrator and compare different types of Multivibraors.
2. Define UTP and LTP?
3. What is hysteresis? Explain how hysteresis can be eliminated in Schmitt trigger?
4. Write a basic principle of time base generator.
5. Write the methods of generating Time base waveforms.
6. Write the difference between current time base generator and voltage time base generators.
7. What is time base generator and write the applications.
8. What are the applications of Schmitt trigger?

## 5 Marks Questions*:*

1. Explain the operation of Fixed bias binary with triggering circuit and waveforms.
2. Draw and explain the working principle of Astable multivibrator circuit and derive the expression for its pulse width.
3. Draw and explain the working principle of Monostable multivibrator circuit and derive the expression for its pulse width.
4. For a Monostable multivibrator calculate the input pulse width for the design values of $R_c$=2KΩ, $R_B$=10KΩ, C=0.1μF, $V_{CC}$=10V and $V_{BE(sat)}$=0.8V.
5. Design a Schmitt trigger circuit to have UTP=6V and LTP=3V using silicon Transistor whose $h_{FE(min)}$=40. Assume necessary data.

6. Compare the voltage and current time base generators with some examples.
7. Draw the circuit diagram of Bootstrap time base generator and explain its operation with necessary waveforms.
8. Draw the circuit diagram of Millter time base generator and explain its operation with necessary waveforms.
9. Draw the circuit diagram of current time base generator and explain its operation with necessary waveforms.
10. Explain how the deviation from linearity is expressed in terms of errors.

TEXT BOOKS:

1. Integrated Electronics, Jacob Millman, Christos C Halkias, McGraw Hill Education.
2. Electronic Devices Conventional and current version -Thomas L. Floyd 2015, Pearson.

REFERENCE BOOKS:

1. Electronic Devices and Circuits, David A. Bell – 5$^{th}$ Edition, Oxford.
2. Electronic Devices and Circuits theory– Robert L. Boylestead, Louis Nashelsky, 11$^{th}$ Edition, 2009, Pearson