Analog Circuits Important Questions PDF

Analog Circuits usually covers transistor biasing and stability, small-signal models and frequency response, feedback amplifiers and oscillators, op-amp circuits and applications, and power amplifiers. Common questions include voltage-divider bias, hybrid-π gain, Miller effect, gain with negative feedback, Barkhausen criterion, RC and Wien bridge oscillator frequency, Schmitt trigger, 555 timer and amplifier efficiency.

Key takeaways

- Biasing: fixed, collector-to-base and voltage-divider bias, Q-point and stability factor.
- Small-signal analysis: h-parameter and hybrid-π models, CE amplifier gain, frequency response and Miller effect.
- Feedback and oscillators: four feedback topologies, $A_f = A/(1 + A\beta)$, Barkhausen criterion and oscillator frequencies.
- Op-amps and power amplifiers: differential amplifier, active filters, Schmitt trigger, 555 timer, class A, B and AB.
- These are practice questions based on common syllabus topics, not verified past papers.

About these important questions

These are **practice questions** built from topics that appear in most Indian B.Tech syllabi for Analog Circuits, including AKTU and universities that follow the AICTE model curriculum. They are **not verified past papers**, and we do not claim that any question will appear in your exam. Unit numbers and topic order differ between universities, so first match each unit below with your own university syllabus. For real previous papers, use your university's official archive. AKTU students can download them from the AKTU old question paper page.

Each unit lists key definitions, derivations or theory questions, numericals with short answer outlines, and long-answer questions. Use the outlines to check your method, then write full solutions yourself.

Unit 1: Transistor Biasing and Stability

Key definitions: DC load line, Q-point, thermal runaway, stability factor S, fixed bias, collector-to-base bias, voltage-divider bias, bias compensation.

Numericals (answer outline):

- Voltage-divider bias with VCC = 12 V, R1 = 40 kΩ, R2 = 10 kΩ, RE = 1 kΩ and VBE = 0.7 V. Outline: VTh = 12 x 10/50 = 2.4 V, VE ≈ 2.4 - 0.7 = 1.7 V, so IE ≈ 1.7 mA (using the approximate method when β RE is much larger than R2).
- Find VCE for the same circuit with a given RC: VCE ≈ VCC - IC(RC + RE).
- Derive the stability factor of the fixed-bias circuit: S = 1 + β, and explain why it is poor.

Long-answer questions: Explain why voltage-divider bias gives a stable Q-point. Explain thermal runaway and how to prevent it.

Unit 2: Small-signal Models and Frequency Response

Key definitions: h-parameters, hybrid-π model, transconductance gm = IC/VT, input resistance rπ = β/gm, cut-off frequencies, gain-bandwidth product, Miller effect.

Numericals (answer outline):

- With IC = 1 mA and VT = 25 mV, gm = 40 mS. A CE amplifier with RC = 5 kΩ (and no load) has a voltage gain of about -gm RC = -200.
- Find the voltage gain, input resistance and output resistance of a CE amplifier with an unbypassed emitter resistor: Av ≈ -RC/RE when β RE is large.
- Find the Miller input capacitance: CM = Cμ(1 + gm RC).

Long-answer questions: Draw the frequency response of an RC-coupled amplifier and explain the low-frequency and high-frequency roll-off. Compare CE, CB and CC amplifiers.

Unit 3: Feedback Amplifiers and Oscillators

Key definitions: positive and negative feedback, voltage-series, voltage-shunt, current-series and current-shunt topologies, desensitivity, Barkhausen criterion.

Numericals (answer outline):

- An amplifier has A = 1000 and β = 0.01. Find the closed-loop gain. Answer: Af = 1000/(1 + 10) ≈ 90.9.
- With negative feedback, bandwidth increases and distortion decreases by the factor (1 + Aβ).
- RC phase-shift oscillator frequency: f = 1/(2πRC√6), with a required gain of at least 29.
- Wien bridge oscillator frequency: f = 1/(2πRC), with a required gain of at least 3.
- Find the frequency of a Colpitts oscillator: f = 1/(2π√(L Ceq)), where Ceq = C1C2/(C1 + C2). Hartley: f = 1/(2π√(Leq C)).

Long-answer questions: Explain the effect of each feedback topology on input and output impedance. Explain the crystal oscillator and why it is very stable.

Unit 4: Op-amp Circuits and Applications

Key definitions: differential amplifier, CMRR, slew rate, input offset, active filters, comparator, Schmitt trigger, precision rectifier, 555 timer.

Numericals (answer outline):

- Find the CMRR of a differential amplifier in dB from its differential and common-mode gains: CMRR = 20 log(Ad/Ac).
- Design a first-order low-pass active filter for a given cut-off frequency: fc = 1/(2πRC).
- Find the threshold voltages of an inverting Schmitt trigger from the resistor values and saturation voltages.
- 555 astable multivibrator: f ≈ 1.44/[(RA + 2RB)C] and duty cycle = (RA + RB)/(RA + 2RB).

Long-answer questions: Explain the instrumentation amplifier and its advantages. Explain the working of a 555 timer in astable and monostable modes.

Unit 5: Power Amplifiers and Multistage Amplifiers

Key definitions: class A, B, AB and C amplifiers, conversion efficiency, crossover distortion, push-pull amplifier, complementary symmetry, current mirror, cascode amplifier, Darlington pair.

Results to remember: maximum efficiency of a series-fed class A amplifier is 25%, transformer-coupled class A is 50%, and class B push-pull is 78.5% (π/4).

Long-answer questions:

- Derive the maximum efficiency of a class B push-pull amplifier.
- Explain crossover distortion and how class AB biasing removes it.
- Explain the working of a simple current mirror and a Widlar current source.
- Explain the cascode amplifier and why it improves high-frequency response.

How to score well in Analog Circuits

- Draw the DC and AC equivalent circuits separately before solving any amplifier question.
- State your assumptions, such as "β RE is much larger than R2" or "capacitors are short at mid-band".
- Learn the oscillator frequency and gain conditions as a table.
- Show waveforms for Schmitt triggers, 555 timers and power amplifiers.

Short-answer (2-mark) questions for Analog Circuits

Short questions test definitions and one-line results. Practise answering each in two to four lines:

1. What is a Q-point?
2. What is thermal runaway?
3. Define stability factor S.
4. Write the expression for transconductance gm.
5. What is the Miller effect?
6. State the Barkhausen criterion.
7. List two advantages of negative feedback.
8. Why is a crystal oscillator very stable?
9. Define CMRR.
10. What is slew rate?

11. What is crossover distortion?
12. What is the maximum efficiency of a class B amplifier? (Answer: 78.5%.)

A 7-day revision plan for Analog Circuits

Use this plan in the last week before the exam. Adjust it to the units and weightage in your own syllabus.

- **Day 1 (Unit 1, Transistor Biasing and Stability):** revise the definitions, then solve the numericals and one long answer from this unit without notes.
- **Day 2 (Unit 2, Small-signal Models and Frequency Response):** revise the definitions, then solve the numericals and one long answer from this unit without notes.
- **Day 3 (Unit 3, Feedback Amplifiers and Oscillators):** revise the definitions, then solve the numericals and one long answer from this unit without notes.
- **Day 4 (Unit 4, Op-amp Circuits and Applications):** revise the definitions, then solve the numericals and one long answer from this unit without notes.
- **Day 5 (Unit 5, Power Amplifiers and Multistage Amplifiers):** revise the definitions, then solve the numericals and one long answer from this unit without notes.
- **Day 6:** attempt one full three-hour practice paper made from these questions, or an official previous paper from your university archive.
- **Day 7:** go through your formula sheet, the short-answer list and every question you got wrong in the practice paper.

Frequently asked questions

Which topics in Analog Circuits are most repeated?

Voltage-divider bias, CE amplifier small-signal analysis, feedback topologies, oscillator frequencies, op-amp applications and power amplifier efficiency appear in most syllabi and papers.

How do I remember oscillator formulas?

Make a small table with the oscillator name, frequency formula and minimum gain: RC phase shift (gain 29), Wien bridge (gain 3), Colpitts and Hartley. Revise it daily in the last week.

Is Analog Circuits important for GATE ECE?

Yes. Biasing, small-signal models, feedback, oscillators and op-amp circuits are part of the GATE ECE analog circuits syllabus, so this preparation helps there too.

Are these questions from real past papers?

No. These are practice questions based on topics that are common in B.Tech syllabi. They are not verified past papers, and no question is promised to appear in your exam. Check your own university syllabus and official previous papers; AKTU students can use the AKTU old question paper archive.

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