

TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2082 Kartik

Exam.	Back		
Level	BE	Full Marks	80
Programme	BEI	Pass Marks	32
Year / Part	II / II	Time	3 hrs.

Subject: - Advanced Electronics (EX 553)

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ Attempt All questions.
- ✓ The figures in the margin indicate Full Marks.
- ✓ Assume suitable data if necessary.

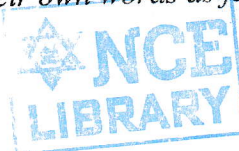
1. Draw the circuit diagram of BJT differential amplifier. Derive its differential and common mode voltage gain. [2+6]
2. Define input bias current and input offset voltage of an Op-amp. Derive the expression of input impedance of closed loop Op-amp configuration. [2+6]
3. Define slew rate of Op-amp. The inverting Op-amp with gain 50 has a slew rate of 0.9 V/ μ s with input signal 0.4V peak and 8 kHz. Determine whether the output will be distorted due to slew rate limitation. If so, find remedies. [2+6]
4. List out demerits of binary weighted resistor DAC. Derive the expression for output voltage of R-2R DAC. [2+6]
5. Why tracking type ADC is better than counter type ADC? Explain the operation of dual slope analog to digital converter (ADC) with necessary figures and expressions. [2+6]
6. What are the applications of isolation amplifier? Find the output voltage of single op-amp instrumentation amplifier with mismatched resistor. [2+6]
7. Draw the circuit diagram of anti-log amplifier using matched transistor. Derive its output voltage expression. [3+4]
8. What are the applications of log-antilog amplifiers? Draw rms detector circuit for sinusoidal waveform using log antilog amplifier and derive its output voltage. [2+5]
9. Explain RC triggering circuit of SCR with necessary figures and waveforms. [6]
10. Explain the working principle of step down dc chopper with necessary derivations. [6]
11. A boost regulator has an input voltage of $V_s = 5V$. the average output voltage $V_a = 15V$ and the average load current $I_a = 0.5A$. The switching frequency is 25 kHz. If $L = 150\mu H$ and $C = 220\mu F$, determine [6]
 - a) The duty cycle
 - b) The ripple voltage capacitor
 - c) The ripple current of inductor
 - d) The critical value of L and C

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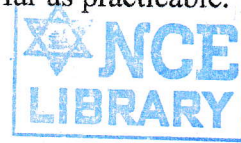


- Why output current of simple current mirror circuit is not exactly equal to reference current? Derive the output resistance of widlar current source. [3+5]
- Define input bias and input offset current of op-amp. Derive the expression for output impedance of closed loop op-amp configuration. [3+5]
- Define slew rate of operational amplifier. How can we reduce the effect of input bias current on output voltage in an op-amp circuit? [2+6]
- What are the advantages of R-2R type DAC? Derive the expression of output voltage and also show output voltage ranges from $-V_{ref}$ to $+V_{ref}$ for bipolar DAC. [2+6]
- Explain the working of successive approximation ADC in brief with suitable example for 6-bit ADC and $V_{ref} = 16V$ and $V_{in} = 10.25 V$. [4+4]
- List out three application area of isolation amplifier. Derive voltage gain of three op-amp instrumentation amplifier. [3+5]
- What are the advantages of transistor logarithmic amplifier then using diode? Derive output voltage expression of logarithmic amplifier using matched transistor. [2+5]
- Implement the following expression using log, antilog amplifier $V_o = V_1^2 + V_2^2 - V_1/V_2$ [7]
- Explain the two transistor model operation of Silicon Controlled Rectifier (SCR). [4]
- Explain the operation of step-down chopper for RLE load with the help of mathematical equations and waveforms. Also, show that maximum ripple current is present when duty cycle $K=0.5$. [8]
- Explain the working of buck regulator with necessary circuits, waveforms and expressions. [6]

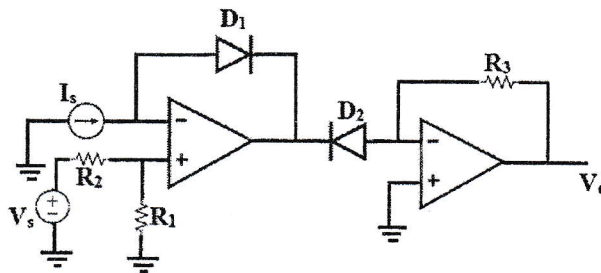
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- What is a Current Mirror? Derive an expression for current gain of Widlar current source with necessary figures. [2+6]
- What are the applications of isolation amplifiers? Find the output voltage of an instrumentation amplifier consisting of three op-amps. [2+6]
- What is input bias current in operational amplifier? What is its effect on the output of an op-amp? How can you minimize the effect of input bias current? [2+3+3]
- Define slew rate. The op-amp has a closed-loop gain of 33 and a slew rate of $0.5 \text{ V}/\mu\text{S}$. The input signal is a complex waveform containing.
 $V_1 = 0.01 \sin(106 t)$
 $V_2 = 0.05 \sin(350 \times 103 t)$
 Determine whether the output is distorted or not due to slew rate limitation. If so, suggest a remedy. [2+4+2]
- Derive the expression for output voltage of n-bit binary weighted resistor DAC. List out advantages of Inverted R-2R ladder DAC. [6+2]
- Explain the operation of Dual slope Analog to Digital Converter (ADC) with necessary figures and expressions. Also mention its advantage and disadvantage. [5+3]
- For the circuit shown in figure below, find the relationship between V_s and V_o . [6]



- Explain the working principle of the RC triggering circuit for turning on a thyristor. [4]
- Define chopper. Explain the working of single phase, full bridge inverter with necessary diagrams and waveforms. [2+2+2+2]
- Implement the following expression using Log, Antilog Amplifier.
 $V_o = V_1^2 - V_2^2 + V_1/V_2$ [6]
- The buck-boost regulator has an input voltage of $V_s = 12 \text{ V}$. The duty cycle $k = 0.25$, and the switching frequency is 25 kHz . The inductance $L = 150 \mu\text{H}$ and filter capacitance $C = 220 \mu\text{F}$. The average load current $I_a = 1.25 \text{ A}$. Determine [2+2+2+2]
 - The average output voltage, V_a
 - The peak-to-peak output voltage ripple, ΔV_c
 - The peak-to-peak ripple current of the inductor, ΔI
 - The peak current of the transistor, I_p

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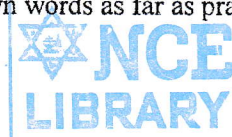
1. Show that a differential amplifier with an active load has double the voltage gain compared to a passive load. [8]
2. List the desired characteristics of an instrumentation amplifier. Explain the working of an optically coupled isolation amplifier. [2+6]
3. Define the common mode rejection ratio of an operational amplifier with the relevant expressions. Show that the gain bandwidth product of an operational amplifier is constant. [3+5]
4. Determine the maximum amplitude of an input sinusoidal wave with signal frequency 5KHz, if it is to be amplified by an op-amp circuit having the voltage gain of 50 and slew rate is equal to 0.4 V/μs, without distortion at the output. [4]
5. What are the method of reducing effect of input bias current in an op-amp? [4]
6. Explain the working of counter type ADC. Mention minimum and maximum conversion time of n bit counter type ADC. [6+2]
7. Discuss why R-2R ladder DAC is preferred to binary-weighted resistor DAC while implementing them as integrated circuits. Explain the working principle of a sigma-delta ADC. [2+6]
8. Derive output voltage expression of log amplifier using matched transistors. [6]
9. A converter is feeding an RL load with $V_s = 220$ V, $R = 5$, $L = 7.5$ mH, $f = 1$ kHz, $k = 0.5$, and $E = 0$ V. Calculate (i) the minimum instantaneous load current (ii) the peak instantaneous load current, (iii) the maximum peak-to-peak load ripple current, (iv) the average value of load current I_a , (v) the rms load current I_0 [5]
10. What is purpose of firing circuits for SCR? Explain working of two types of firing circuits and compare them. [1+4]
11. Implement following expression using log and antilog amplifier. [8]
$$V_o = V_1^2 - 2V_1V_2 + V_2^2$$
12. What is the difference between linear mode and switch mode power supply? Explain the working of Buck Regulator with necessary diagrams. [2+6]

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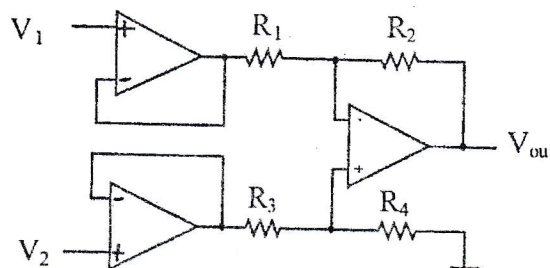
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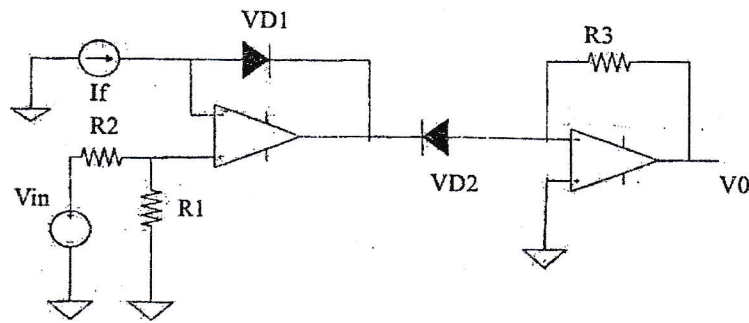
1. Why the output current of the simple current mirror circuit not equal to reference current? Derive an expression for an current gain of widlar current source. [2+5]
2. What is slew rate? The operational amplifier has a slew rate of $0.5\text{V}/\mu\text{s}$ and closed loop gain -33. Determine whether the output will be distorted due to the slew rate limitation when input is $V_{in} = 0.071\text{V}$ rms at 32 kHz. If distortion occurs, find remedies other than changing the input signal. [2+5]
3. Define input offset current and input bias current. How to reduce the effect of input bias current on op-amp? [2+5]
4. Derive output voltage expression of inverted R-2R ladder DAC. [7]
5. Compare different type of Analog to Digital converter. In an 8-bit dual slope A/D converter. $R_1 = 20\text{k}\Omega$ and $C = 0.001\mu\text{F}$. An analog input of value -0.25V is integrated for $T_1 = 160\mu\text{s}$.
 - a) What is the maximum voltage reached in the integration? [2+5]
 - b) If the integrator is switched to $+5\text{V}$, how long does it take to reach 0V .
 - c) If the counter is clocked at 3.125MHz , what is the digital output after the conversion?
6. Derive voltage gain of following amplifier circuit. [7]



7. Why log-antilog amplifiers are essential? Derive the expression for output of a four quadrant multiplier circuit. [1+6]

8. Find the expression of output voltage for the circuit shown in figure below.

[4]



9. Explain RMS detector using log and antilog amplifier.

[3]

10. A half wave rectifier circuit employing as SCR is adjusted to have a gate current of 1 mA. The forward breakdown voltage of SCR is 50V for I_g : 1mA. If sinusoidal voltage of 100V peak is applied. Find

- Firing angle
- Conduction angle
- Average output voltage,
- In the circuit if holding current is 80 mA and load resistance is 100Ω find average voltage in this case.

[1+1+2+3]

11. How can you classify choppers? Explain the principle of step-down chopper with RL load [2+5]

12. The buck-boost regulator has an input voltage of 12 V. The duty cycle (K) is 0.25 and the switching frequency is 25 kHz. The inductance is $15\mu\text{H}$ and filter capacitance is $220\mu\text{F}$. The average load current is 1.25 A. Determine

[10]

- The average output voltage (V_a)
- The peak-to-peak output ripple voltage (ΔV_c)
- The peak-to-peak ripple current of inductor (ΔI)
- The peak current of the transistor (I_p)
- The critical values of L and C

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1. Show that the voltage gain of the differential amplifier with active load is the twice to that with passive load. [7]
2. The inverting op-amp configuration has a feedback resistance of $470\text{k}\Omega$ and input resistance of $10\text{k}\Omega$. If the input signal is $0.1\sin(200000t)$, determine whether the output will be distorted due to slew rate limitation of op-amp. If so, find a remedy. The op-amp has a slew rate of $0.5\text{V}/\mu\text{s}$. [7]
3. Define common mode rejection ratio of Op-Amp with mathematical expressions. Prove that the gain bandwidth product of Op-Amp is constant. [3+5]
4. Derive the expression for output voltage of R-2R ladder DAC (voltage mode). List out demerits of Binary weighted resistor DAC. [5+2]
5. For a 5-bit DAC with the reference voltage V_r being 10V , if there is the fluctuation in the reference voltage of about 10% what will be the deviation in the output for MSB and LSB due to this fluctuation? [8]
6. List out the characteristics of Instrumentation Amplifier. Explain the operation of optically coupled isolation amplifier. [2+5]
7. Derive output expression of log amplifier using matched transistor with necessary circuit diagram. [7]
8. Explain working principle of SCR with its characteristics curve. Discuss turning ON process of SCR. [4+4]
9. Draw the detailed circuit diagram for four quadrant multiplier and derive its input and output relationship. [7]
10. The buck-boost regulator has an input voltage of $V_S=12\text{V}$. The duty cycle $k=0.25$ and the switching frequency is 25kHz . The inductance $L=150\mu\text{H}$ and filter capacitance $C=220\mu\text{F}$. The average load current $I_a=1.25\text{A}$. Determine (a) the average output voltage, V_a (b) the peak-to-peak output voltage ripple, ΔV_C (c) the peak-to-peak ripple current of inductor, ΔI , (d) the peak current of the transistor, I_p and (d) the critical value of L and C . [8]
11. Write short notes on: [3×2]
 - a) Biasing circuit in IC design
 - b) Application of Log and Antilog Amplifier