

TRIBHUVAN UNIVERSITY  
INSTITUTE OF ENGINEERING  
**Examination Control Division**  
2079 Chaitra

| Exam.       | Regular |            |        |
|-------------|---------|------------|--------|
| 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.



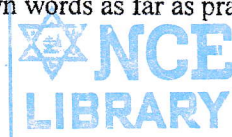
1. Show that a differential amplifier with an active load has double the voltage gain compared to a passive load. [8]
2. List the desired characteristics of an instrumentation amplifier. Explain the working of an optically coupled isolation amplifier. [2+6]
3. Define the common mode rejection ratio of 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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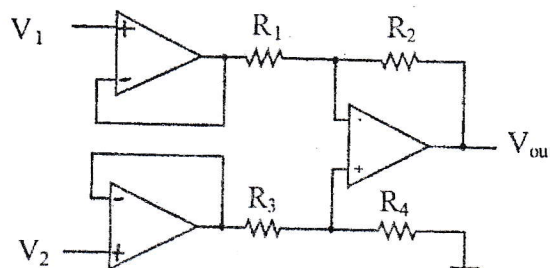
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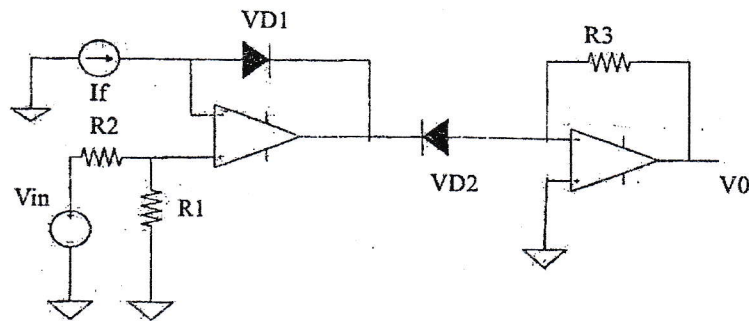
1. Why the output current of the simple current mirror circuit not equal to reference current? Derive an expression for an current gain of widlar current source. [2+5]
2. What is slew rate? The operational amplifier has a slew rate of  $0.5\text{V}/\mu\text{s}$  and closed loop gain -33. Determine whether 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  $-0.25\text{V}$  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  $0\text{V}$ .
  - c) If the counter is clocked at  $3.125\text{MHz}$ , 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  $100\Omega$  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 ( $\Delta V_c$ )
- The peak-to-peak ripple current of inductor ( $\Delta I$ )
- 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  $10\text{V}$ , 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  $25\text{kHz}$ . 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 (a) the average output voltage,  $V_a$  (b) the peak-to-peak output voltage ripple,  $\Delta V_C$  (c) the peak-to-peak ripple current of inductor,  $\Delta I$ , (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