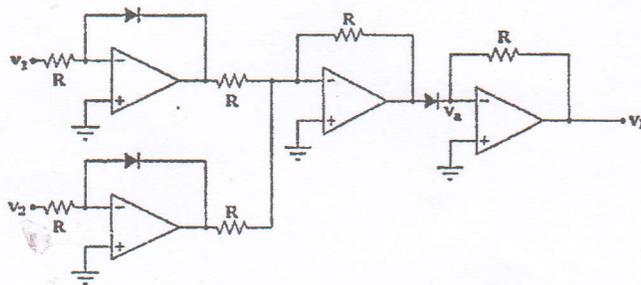


Exam.	Back		
Level	BE	Full Marks	80
Programme	BEX	Pass Marks	32
Year / Part	III / I	Time	3 hrs.

**Subject: - Advanced Electronics (EX601)**

- ✓ 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. Find the current gain of Wilson current mirror circuit. What is the role of Emitter Resistance in Widlar current source? [4+3]
2. What is the cause of Slew Rate Limiting? The inverting op-amp with  $R_f = 330K$  and  $R_1 = 10K$  has a slew rate of  $0.5V/\mu s$ . The Amplifier must be capable of amplifying the input signal  $= 0.05\sin(350000t)$ . Determine whether the output will be distorted due to the slew rate limitation, if so find a remedy. [2+5]
3. What do you understand by input offset voltage and output offset voltage of op-amp. What are the effects of input offset voltage on output voltage? How do you reduce the effect of offset voltage? [7]
4. What do you understand by Bi-polar type Digital to Analog (D/A) Converter? Derive the expression of output voltage of Bipolar type D/A converter? [1+6]
5. Explain the working principle of a Flash type ADC with example. An 8 bit successive approximation ADC is driven by a 1 MHz clock, find its conversion time. [5+2]
6. What are the characteristics of instrumentation amplifier? A certain IA has gain of 40dB and a CMRR of 100dB. It is in a noisy environment in which a signal has a level of 50mV and common mode noise is 100mv. Determine  
a) Common mode gain b) Signal output c) Noise output d) SNR [2+5]
7. Draw the transfer curve of log amplifier. Draw the circuit diagram for matched transistor log amplifier and hence derive the input and output voltage relationship. Explain how the network can be made independent of the temperature. [7]
8. For the circuit shown in figure below, all Diodes are matched find the relationship between  $v_1$ ,  $v_2$  and  $v_b$ . [6]



9. The latching current for a thyristor inserted between a dc source voltage of 100V and a load being 65mA. Calculate the minimum width of gate pulse required to turn on the thyristor when the load is
- a) Purely Inductive having inductance of 80mH and
  - b) Consisting of resistance and inductance of 20 ohm and 100mH respectively. [4+4]
10. A buck regulator has an input voltage of  $V_s = 15V$ . The required output voltage is  $V_a = 7V$  at  $R = 500$  ohm and peak to peak output voltage ripple is 15mV. The switching frequency is limited to 20KHZ. If the peak to peak ripple current of the inductor is limited to 0.7A, Determine:
- a) Duty cycle
  - b) Filter inductance
  - c) Filter capacitance
  - d) Critical values of L and C [1+2+2+2]
11. Write short notes on: (Any two) [5+5]
- a) Differential amplifier with active load
  - b) Isolation amplifier
  - c) Biasing circuit in IC Design

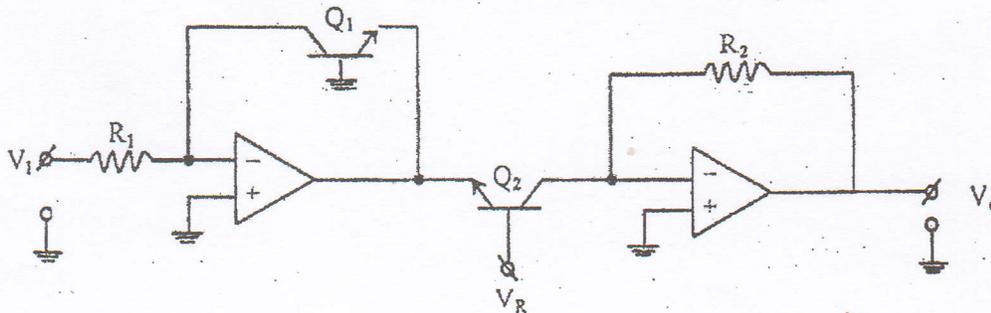
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Exam.	Regular		
Level	BE	Full Marks	80
Programme	BEX	Pass Marks	32
Year / Part	III / I	Time	3 hrs.

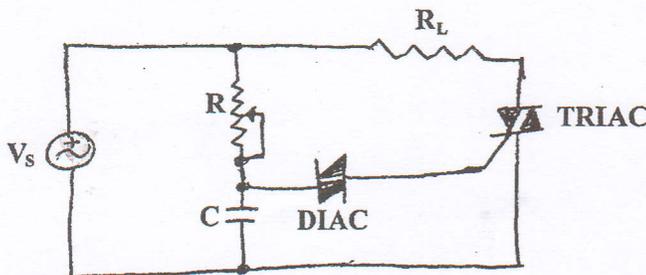
**Subject: - Advanced Electronics (EX601)**

- ✓ 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. What is a Current Mirror and its advantages? Find the output resistance of Widlar Current Source. [3+5]
2. Explain Slew rate of an Op-Amp with necessary expressions. Prove that the Gain Bandwidth Product of Op-Amp is Constant. [3+5]
3. Define input offset voltage, input offset current and input bias current of an operational amplifier. Find the input resistance closed loop op-amp circuit. [3+4]
4. Derive the expression for output voltage is non-inverted R-2R Ladder Type Digital to Analog converter. [7]
5. Explain the working principle of dual slope analog to digital converter (ADC) with necessary circuit diagram. Explain why its output is accurate. [7]
6. What are the features of Instrumentation Amplifier? Derive the expression of output voltage of 3 op-amp Instrumentation Amplifier. [2+5]
7. For the circuit shown below. Find the relationship between  $V_0$  and  $V_1$ . [7]



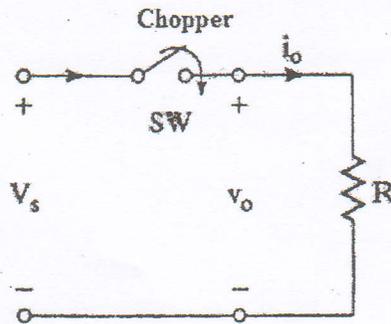
8. Explain the two transistor analogy of SCR with necessary mathematical expression. In the TRIAC firing circuit the parameter are input voltage ( $V_s$ ) = 230V, 50Hz, DIAC breakdown voltage is 25V,  $C = 0.6\mu\text{F}$ , R can be varied from  $2000\Omega$  to  $20000\Omega$ . Find the minimum and maximum firing angle. [3+5]



9. What are inverters? For the chopper shown below has a resistive load  $R = 10\Omega$ , the input voltage is  $V_s = 220V$ , when the chopper remains on its voltage drop  $V_{ch} = 2V$  and the chopping frequency is  $f = 1\text{ kHz}$  with duty cycle of 50%. Derive and determine

- The average output voltage
- The RMS value of output voltage
- The chopper efficiency

[2+1+2+2]



10. What is the importance of Freewheeling Diode? Explain the principle of step up operation in Chopper with necessary figures and expressions.

[2+6]

11. Write short notes on: (Any two)

[3+3]

- Current Steering Circuits
- Generation of RMS output of Sinusoidal wave using log antilog application
- Switching Regulators

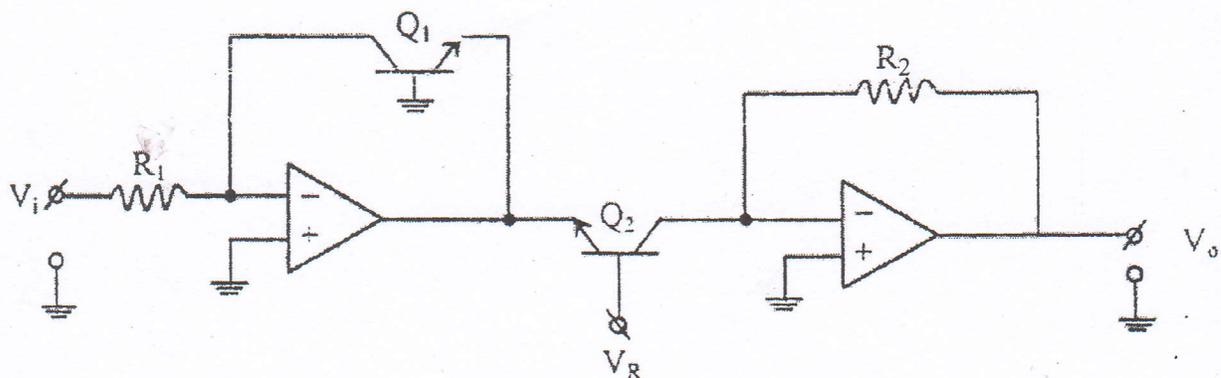
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Exam.	Back		
Level	BE	Full Marks	80
Programme	BEX	Pass Marks	32
Year / Part	III / I	Time	3 hrs.

**Subject:** - Advance Electronics (EX601)

- ✓ 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. What are the benefits of Widlar current source as compared to simple current source? Derive an expression for an output resistance of Widlar Current Source. [3+5]
2. Show the effect of input offset voltage in Op-Amp. How can it be minimized? Define power supply rejection ratio of Op-Amp. [3+3+2]
3. An amplifier using an op-amp with a slew rate  $SR = 1V/\mu$  sec has a gain of 40 dB. Peak value of 100 mV, 20 KHz sinusoidal wave is applied to the input of amplifier. Determine whether the output will be distorted due to slew rate limiting of op-amp. If so, find remedies. [7]
4. Derive the expression for output voltage in inverted R-2R ladder type Digital to Analog converter (DAC). What are the advantages of it? [5+2]
5. A dual slope integrator with a clock frequency of 12KHZ,  $V_{ref} = 100mv$  with 1000 clock pulses set for T1. Find out the digital counter output if analog input equals 100mv. Find the conversion time. [2+2+3]
6. What are the features of Instrumentation Amplifier? Hence design a three op amp Instrumentation Amplifier having gain 50. [2+5]
7. Draw the detailed circuit diagram for four quadrant multiplier and derive its input and output relationship. [7]
8. For the circuit shown in figure below. Find the relationship between  $V_0$  and  $V_i$ . [4]



Exam.	Regular		
Level	BE	Full Marks	80
Programme	BEX	Pass Marks	32
Year / Part	III / I	Time	3 hrs.

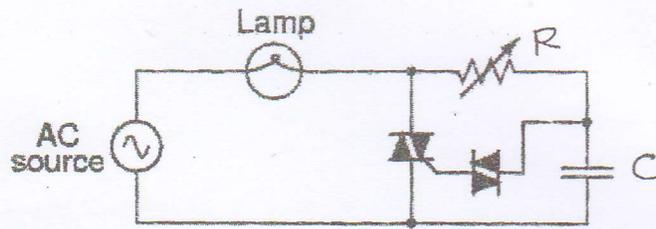
*Subject: - Advance Electronics (EX601)*

- ✓ 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 the voltage gain of the differential Amplifier with active load is twice to that with passive load. [7]
2. In a closed-loop inverting configuration of an op-amp, the input resistance and the feedback resistance are 1 KΩ and 33 KΩ respectively. (i) Determine the value of  $V_p$  for an undistorted output if an input to the current is  $V_{in} = V_p \sin(2\pi ft)$ , where  $f = 1$  kHz and slew rate = 0.6 V/μs. (ii) If the value of  $V_p$  is assumed to be 5V, State two possible remedies in the circuit to have an undistorted output. [3+3+1]
3. What do you understand by input bias and input offset currents of op-amp? What are the effects of input bias currents on output voltage? How do you reduce the effect of input bias currents? [2+2+3]
4. A count up type ADC of 4 bit has full scale voltage ( $V_{FS}$ ) = 16.00V. The minimum conversion time is 0.1ms. Determine: [2+3+3]
  - a) PRF of clock used
  - b) Resolution
  - c) The Digital output and the conversion time for  $V_{in} = 6.25V$
5. Derive the expression for output voltage in Bipolar type Digital to Analog converter (DAC). Draw the transfer curve for digital input and analog output for 3 bit bipolar type DAC? [7]
6. List out the ideal characteristics of Instrumentation Amplifier. Explain the operation of optically coupled isolation amplifier. [2+5]
7. Draw the circuit diagram for matched transistor antilog amplifier and hence derive the input and output voltage relationship. Explain how the effect of temperature can be minimized. [7]
8. Construct a circuit that generates square root of an input voltage and derive its input-output relationship. Draw a circuit that produces the output voltage  $V_o = \sqrt{(V_1 \cdot V_2)^2 + (V_3 \cdot V_4)^2}$  [3+4]
9. Is it possible to get variable output voltage in inverter? How? Derive expression for average output voltage of SCR full wave rectifier. [2+5]
10. Derive expression for average output voltage, peak to peak ripple current of inductor of Buck-Boost regulator with necessary figure and wave forms. [7]

11. In the Triac firing circuit, input voltage is 230 V, 50 Hz, Diac breakdown voltage is 20 V, capacitance  $C = 0.5 \mu\text{F}$ ,  $R$  can be varied from  $5 \text{ K}\Omega$  to  $15 \text{ K}\Omega$ . Find the minimum and maximum firing angle of Triac.

[7]



12. Explain (Any one)

[3]

- a) Differential Amplifiers
- b) Process of RMS detection of Sine wave using log antilog applications.

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9. 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 100V for  $I_g = 1\text{mA}$ . If sinusoidal voltage of 200V peak is applied. Find [2+2+2+2]
- Firing angle
  - Conduction angle
  - Average current, assume load resistance =  $100\Omega$
  - In this circuit if holding current  $I_H = 200\text{mA}$ . Find average current in this case
10. Define chopper circuit. Explain the working principle of signal phase half bridge inverter, with the necessary circuits and waveforms. [2+5]
11. The buck-boost regulator has input voltage  $V_s = 10\text{V}$ , duty cycle  $k = 45\%$  and switching frequency of 25KHZ, the inductance  $L = 0.1\text{mH}$  filter capacitance  $C = 0.2\mu\text{F}$  and average load current  $I_a = 1200\text{mA}$ . Determine: [2+2+3]
- The average output voltage
  - Peak to peak output ripple voltage
  - Peak to peak output ripple current
12. Write short notes on: (any one) [3]
- Differential amplifier with Active Load
  - Generation of RMS output of sinusoidal wave using log antilog application

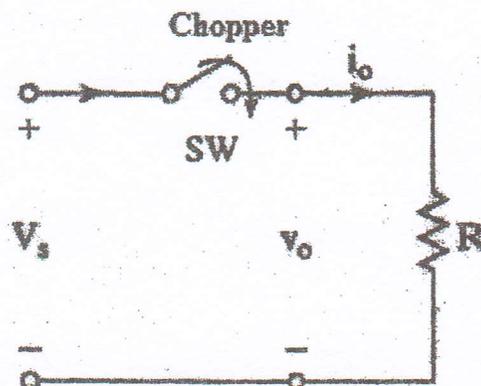
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Exam.	New Back (2066 & Later Batch)		
Level	BE	Full Marks	80
Programme	BEX	Pass Marks	32
Year / Part	III / I	Time	3 hrs.

**Subject: - Advance Electronics (EX601)**

- ✓ 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. What are the essential conditions for a current mirror to work? Derive an expression for an output resistance of Widlar Current Source. [2+5]
2. Explain Slew Rate of an operational amplifier. An inverting configuration op amp has feedback resistor  $470\text{k}\Omega$  and output resistor  $10\text{k}\Omega$ . If input signal is  $0.1\text{Sin}(200000t)\text{V}$ , determine whether the output will be distorted due to slew rate limiting of op amp. If so find remedy. The op-amp has slew rate of  $0.5\text{V}/\mu\text{s}$ . [1+6]
3. Describe relationship of gain and bandwidth of an op amp and prove gain bandwidth product is constant. [1+6]
4. Explain the operation of Bipolar DAC. Write disadvantages of Weighted Resistor DAC. [5+2]
5. Explain the working principle of dual slope analog to digital converter (ADC) with circuit diagram. Explain why its output is accurate. [7]
6. What are the features of Instrumentation Amplifier? Hence design a three op amp Instrumentation Amplifier having gain 20. [2+5]
7. Explain the operation of log amplifier using matched transistor. Explain how the effect of temperature can be minimized in this circuit. [7]
8. How four quadrants multiplier differs from single quadrant multiplier? Derive output voltage of four quadrant multiplier with necessary diagrams. [1+7]
9. Explain the working principle of Silicon Controlled Rectifier (SCR) utilizing two transistor models along with its VI curve. [7]
10. For the chopper shown in figure below has a resistive load  $R = 10\Omega$ , the input voltage is  $V_s = 220\text{V}$ , when the chopper remains ON its voltage drop,  $V_{ch} = 2\text{V}$  and the chopping frequency is  $f = 1\text{kHz}$  with duty cycle of 50%. Determine: [2+2+2]
  - a) The average output voltage.
  - b) The RMS value of output voltage.
  - c) The chopper efficiency.



11. Explain the operation of Buck regulator with necessary diagram and derivation. [7]
12. Explain (any one) [3]
  - i) Differential Amplifiers

Exam.	Regular		
Level	BE	Full Marks	80
Programme	BEX	Pass Marks	32
Year / Part	III / 1	Time	3 hrs.

**Subject:** - Advanced Electronics (EX601)

- ✓ 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.

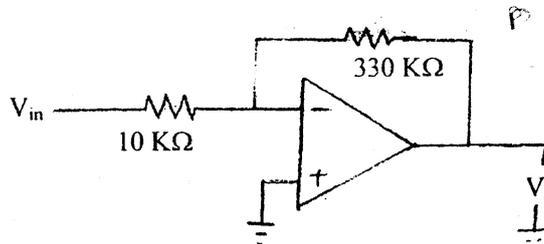
1. What are the basic requirement for current mirror circuit? Why output current of simple current mirror circuit not being exactly equal to the input reference current? Determine the emitter resistance,  $R_E$  for wilder current source which supplies  $10 \mu\text{A}$  from a reference of current of  $1 \text{ mA}$ . [2+2+3]
2. The op amp in the given figure has slew rate of  $0.5 \text{ V}/\mu\text{S}$ . The input signals are as follows: [4+3]

$$V_1 = .01 \sin 10^6 t$$

$$V_2 = .05 \sin (350 \times 10^3) t$$

$$V_3 = .1 \sin (200 \times 10^3) t$$

$$V_4 = .1 \sin (50 \times 10^3) t$$

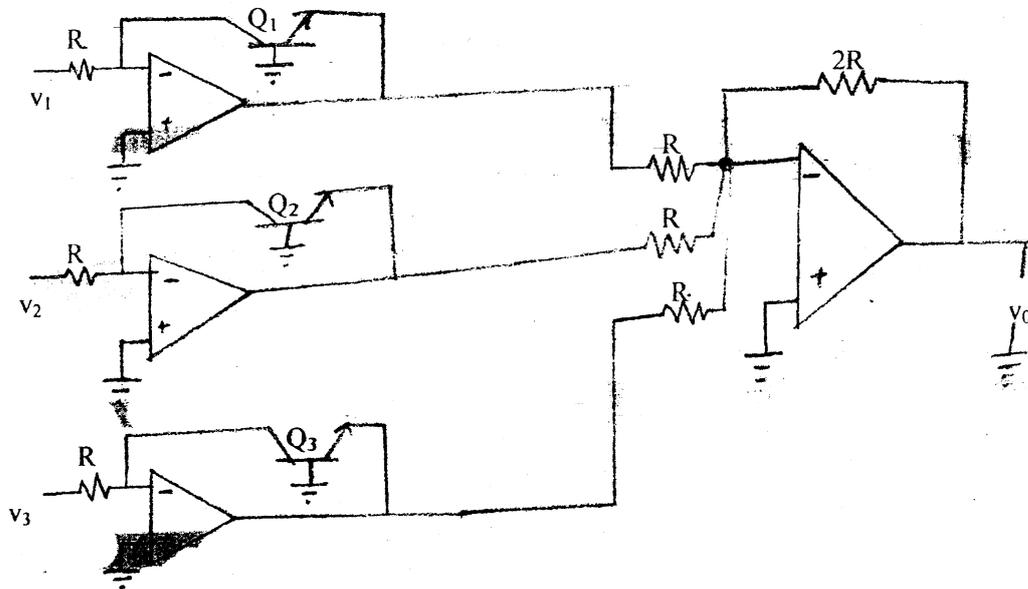


Determine whether the output will get distorted due to slew rate limitation? Find the new value of feedback resistor such that none of the signal gets distorted.

3. Discuss noise in operational amplifier circuits with necessary diagram and suggest the measures to be taken to minimize the interval noise. [7]
4. Draw a circuit diagram for 5 bit R-2R (voltage type) DAC. If the reference voltage for the DAC is  $1\text{V}$ , the binary input is  $10110$ , find the output voltage. [4+2]
5. Draw the block diagram of Dual-slope type ADC and explain about its working principle with necessary diagram. Explain briefly about integral linearity of the DAC. [6+2]
6. What are the advantages of 3 op-amp (Isolation Amplifier). IA over 1-op amp and 2 op-amp IA? List out the application of Isolation amplifier. Explain the block diagram of electromagnetically coupled isolation amplifier. [2+2+3]

7. Find the relationship of input and output voltage in the following figure.

[4]



8. Why log-Antilog circuits are required? Draw the circuit diagram of analog multiplier and explain it. [1+6]

9. Mention the drawback of DIAC? Describe the operating principle of TRIAC with necessary diagrams and explain why it is called four quadrant operation? [2+5]

10. What are choppers? Explain the working principle of single phase, full bridge inverter with necessary diagrams and waveforms. [2+5]

11. What is an inverter? Explain the Buck switching regulator with required necessary diagram and waveforms. [2+5]

12. Write short notes on: [3+3]

- a) Application of Log and Antilog Amplifier
- b) SMPS

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Exam.	Regular		
Level	BE	Full Marks	80
Programme	BEX	Pass Marks	32
Year / Part	III / I	Time	3 hrs.

**Subject: - Advanced Electronics (EX601)**

- ✓ 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.

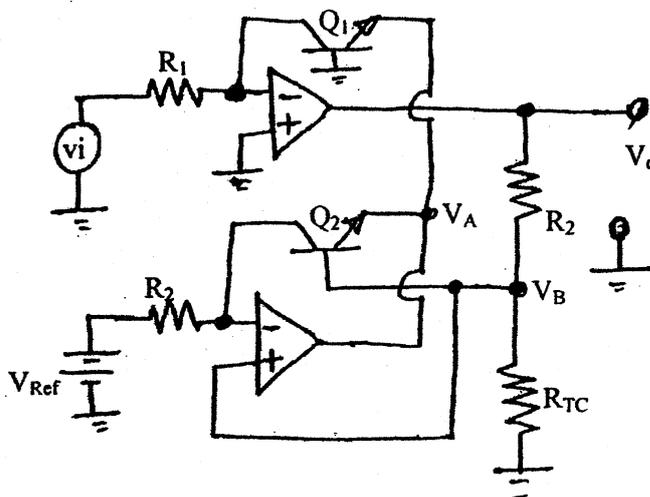
1. What are the essential condition for a current mirror circuit to work? Derive an expression for an output resistance of widlar current source. [2+5]
2. Define slew Rate of an operational amplifier. The inverting op-amp with  $R_f = 330 \text{ K}\Omega$  and  $R_1 = 10 \text{ K}\Omega$  has a slew rate of  $0.5 \text{ v}/\mu\text{s}$  with input signal equal to  $0.1\sin(200000t)$ . Determine whether the output will be distorted due to slew rate limitation, if so find remedy. [2+5]
3. What is input offset voltage and input offset current of an operational amplifier? Find the output resistance of closed loop op-amp. [2+5]
4. What are the advantages of R-2R type DAC? Derive the expression for output voltage in inverted R-2R type DAC. [2+5]
5. Explain the working principle of a dual slope ADC and prove that its output is independent of RC time constant. Justify that the converter is inherently noise immune. [4+3]
6. Explain the operation of Electromagnetic Coupled Isolation amplifier. Certain Instrumentation amplifier has a gain of 40dB and CMRR of 90dB. It is used in a noisy environment in which the signal has a level of 35 mV and common mode noise level of 150 mV. Determine common mode gain, signal output and noise output. [4+3]
7. Derive the transfer function for Log amplifier using matched transistor. [5]
8. What do you understand by four-quadrant multiplier? Draw the circuit diagram and derive expression for its output voltage. [2+5]
9. Can two complementary BJTs be used to make SCR? Explain about turning OFF of SCR. [2+5]
10. Classify chopper on the basis of power flow. Explain the principle of step-up converter with resistive load. [2+5]
11. A buck regulator has an input voltage of  $V_s = 14\text{v}$  the required output voltage is  $V_a = 6\text{v}$  at  $R = 500\Omega$  and peak to peak output voltage ripple is 15mv the switching frequency is limited to 20KHZ. If the peak to peak ripple current of the inductor is limited to 0.7A determine: (a) the duty cycle (b) Filter inductance L (c) Filter capacitance C and (d) critical values of L and C. [1+2+2+2]
12. Discuss an ac analysis of differential amplifier with necessary diagrams and mathematical expressions. [5]

Exam.	Regular		
Level	BE	Full Marks	80
Programme	BEX	Pass Marks	32
Year / Part	III / I	Time	3 hrs.

**Subject: - Advanced Electronics (EX601)**

- ✓ 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. What are the reasons for the output current of a simple current mirror not being exactly equal to the reference current? Show that the voltage gain of a differential amplifier with active load is doubled compared to that with passive load ( $R_C$ ). [2+5]
2. Show the effect of input bias current in op-amp circuit. Derive the expression for closed loop output impedance of inverting op-amp configuration. [4+3]
3. The inverting opamp configuration has a feedback resistance of 470 K $\Omega$  and an input resistance of 10 K $\Omega$ . If the input signal is  $0.1 \sin(200000t)$ , determine whether the output will be distorted due to slew rate limitation of opamp. If so, find a remedy. The opamp has a slew rate of 0.5V/ $\mu$ s. [7]
4. Draw circuit for 4-bit inverted R-2R ladder network type DAC. Find expression for output voltage and explain why an inverted R-2R ladder DAC is better than R-2R ladder DAC. [2+4+1]
5. Explain the working principle of dual slope integrating type ADC with necessary diagrams. Why is the output of quad slope ADC more accurate than that of dual slope ADC? [5+2]
6. List out the practical characteristics of instrumentation amplifier. What are the advantages of 3 op-amp instrumentation amplifier over one op-amp and two op-amp instrumentation amplifiers? Explain the operation of optically coupled isolation amplifier. [2+2+3]
7. For the circuit shown in figure below, find the expression for the output voltage ( $V_o$ ). [4]



8. How can you find the RMS value of a sinusoidal signal using log and antilog amplifiers? Explain with necessary derivations and circuit diagrams. [7]
9. Describe the operation of thyristor using two transistor models and illustrate its characteristic curve for differing gate current values. [4+3]
10. What are choppers? Explain the working principle of single phase, full bridge inverter with necessary circuits and waveforms. [2+5]
11. The Buck-Boost regulator has input voltage  $V_s = 15V$ , duty cycle  $K = 40\%$  and switching frequency of 20 KHz. The inductance  $L = 120 \mu H$ , filter capacitance,  $C = 200 \mu F$  and average load current  $I_a = 1.25 A$ . Determine (i) the average output voltage (ii) peak to peak output ripple voltage and (iii) peak to peak output ripple current. [2+2+3]
12. What is the advantage of BJT log amplifier over diode log amplifier? List out the applications of log-antilog amplifier. [1+2]
13. Explain the principle of biasing circuit in IC design. [3]

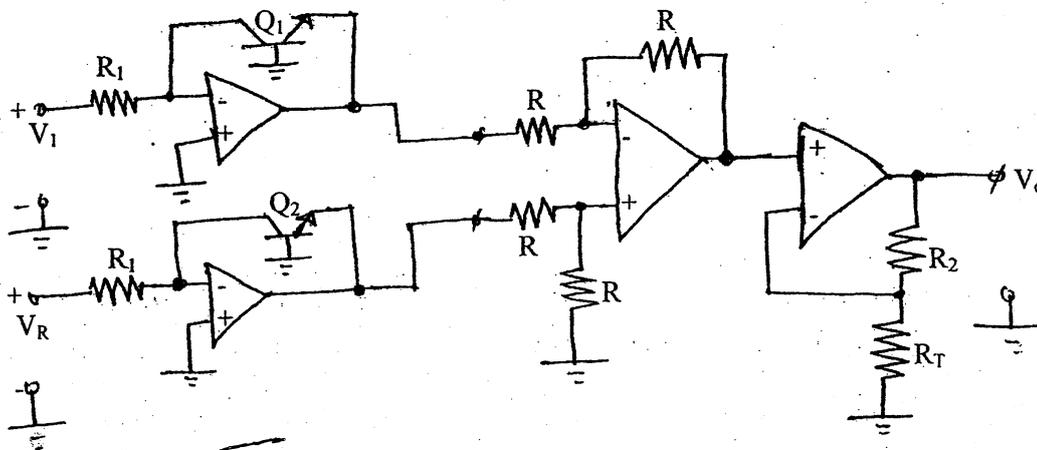
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Exam.	Regular		
Level	BE	Full Marks	80
Programme	BEX	Pass Marks	32
Year / Part	III / I	Time	3 hrs.

**Subject: - Advanced Electronics (EX 601)**

- ✓ 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. What are the essential conditions for a current mirror to work? Derive an expression for an output resistance of Widlar Current Source. [2+5]
2. Define Slew Rate of an operational amplifier. An amplifier has a bandwidth of 20KHz and closed loop gain of 20. Find the maximum peak input signal that can be applied to obtain undistorted sine wave output. Assume  $SR = 1V/\mu s$ . [2+5]
3. Explain the effect of positive and negative input bias current on output voltage of an op-amp and suggest methods of reduction. [7]
4. Derive the expression for output voltage in inverted R-2R ladder type Digital to Analog Converter (DAC). What are the advantages of R-2R type DAC? [5+2]
5. Explain the operation principle of count up/down and tracking type ADC with necessary diagram. [7]
6. Find the expression for output voltage of three op-amp instrumentation amplifier. Also, explain how it rejects common mode signal. [5+2]
7. Find expression of output voltage for the circuit shown in figure below. ( $Q_1$  and  $Q_2$  are matched transistors). [4]



8. Design a circuit that produces output voltage  $V_o = \left(\frac{V_x}{V_y}\right)^\alpha \cdot V_z$  using Log and Antilog amplifiers, where  $\alpha > 1$  and  $V_x$ ,  $V_y$  and  $V_z$  are analog input voltages. (Hint:  $\ln(x^a) = a \ln(x)$ ) [7]
9. The gate current in a SCR half wave rectifier is adjusted to 1.25mA and the forward break-down voltage of SCR corresponding to this gate current is 110V. The applied voltage is 220V, the load resistance is  $150\Omega$  and holding current is zero. Determine: [2+1+2+2]
- Firing angle
  - Conduction angle
  - Average output voltage
  - Average current
10. Classify chopper. Explain principle of step-down chopper with RL load. [2+5]
11. Explain the working principle of Boost Regulator with necessary circuit and expressions. [7]
12. Write short notes on: [3+3]
- Differential Amplifier
  - Applications of log-antilog amplifier.

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