

TRIBHUVAN UNIVERSITY  
INSTITUTE OF ENGINEERING  
**Examination Control Division**  
2080 Baishakh

Exam.	Back		
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. Define current mirror. Derive input-output current relationship of simple current mirror circuit. Why output of simple current mirror circuit not being exactly equal to input reference current? [2+4+3]
2. Define Input offset voltage of OP-Amp. Show its effect. How can we reduce the effect of input offset voltage in OP- Amp? [2+2+4]
3. The inverting op-amp with  $R_F = 330 \text{ k}\Omega$  and  $R_I = 10\text{k}\Omega$  has slew rate of  $0.5 \text{ V}/\mu\text{s}$  with input signal of  $0.1 \sin(200000t)$ . Determine whether the output will be distorted due to slew rate limitation of op-amp. If so, find remedies. [8]
4. Design a block diagram of 8-bit flash type ADC by using two 4-bit flash types ADC. How can we minimize the error appear in count-up type ADC? [6+2]
5. Derive the expression for output voltage of Inverted R-2R ladder DAC. [8]
6. Derive voltage gain of single op-amp Instrumentation amplifier with zero source resistance condition. Mention disadvantages of signal Op-amp Instrumentation Amplifier. [5+2]
7. Explain logarithmic amplifier using matched transistor with its transfer function and circuit diagram. [8]
8. Implement following expression using log and antilog amplifier. [8]
$$V_0 = V_1^2 + 2V_1V_2 + V_2^2$$
9. A full controlled rectifier employs 2SCRs and 2 diodes in bridge configuration to rectify 230V, 50Hz ac mains and gives an output of 150V to a resistive load of  $100\Omega$ . Find the firing angle, the time during which the SCR remains off and the load current. [4+2+2]
10. Explain the working of Buck- Boost regulator with necessary circuit diagram, wave forms and derivations. [8]

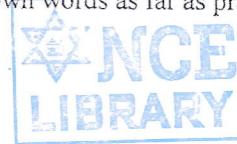
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TRIBHUVAN UNIVERSITY  
INSTITUTE OF ENGINEERING  
**Examination Control Division**  
2079 Bhadra

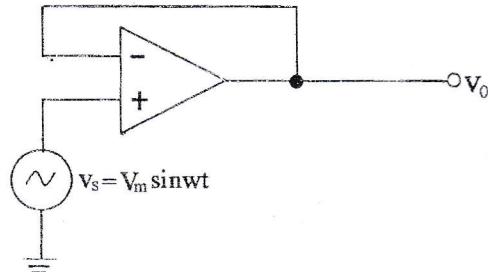
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**Subject:** - Advanced Electronics (EX 601)

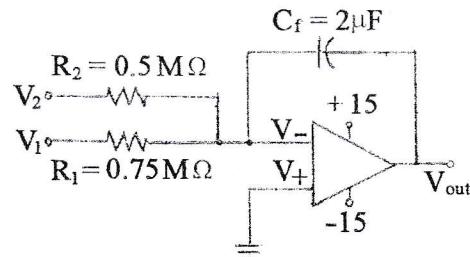
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1. The BJT differential amplifier has  $I_0 = 2\text{mA}$ ,  $R_C = 5\text{K}\Omega$  and  $r_n = 50\text{ K}\Omega$ . Find  $V_{01}$  and  $V_{02}$  if the input voltage are equal to  $V_1 = 50\text{ mV}$  and  $V_2 = 30\text{ mV}$  and the bias component of  $V_{01}$  and  $V_{02}$  are both equal to zero. What are the advantages of amplifier using active load then using passive load in IC? [5+2]
2. a) With the help of proper model, explain the concept of compensating resistor ( $R_C$ ) used to nullify the effects of input bias currents in an Op-Amp.  
Also show that:  $R_C = R_i \parallel R_f$ , where,  
 $R_i$  = Resistor at the inverting input  
 $R_f$  = Feedback resistor [5]
- b) Explain Gain-Bandwidth product and 3 – dB frequency of an Op-amp. [3]
3. a) Explain the physical significance of slew rate in case of Op-Amp. Calculate the slew rate of the voltage follower circuit shown below: [2+3]



- b) Explain PSRR and its importance. [2]
4. How does SAR ADC work? Justify with suitable example. Why does dual slope type ADC have accurate output? [6+1]
5. Design a block diagram of 8-bit flash type ADC by using two 4-bit flash types ADC. How can we minimize the error appear in count-up type ADC. [6+2]
6. Mention advantages of isolation amplifier. Find the value of  $V_{out}$  for the circuit shown in figure below if  $V_1 = 10 \sin(200t)$  and  $V_2 = 15 \sin(200t)$ , assume that op-amp is ideal with infinite gain. [2+6]



7. Explain the principle of exponential amplifier with necessary figure and derivation. [5]
8. Design a circuit that produces the following output voltage: [8]
- $$V_0 = \{(V_1 V_2)^4 - (V_1 V_2 V_3)^5\}^{1/2}$$
9. Mention at least four members of the Thyristor family. Explain the methods to turn on an SCR. [2+5]
10. a) What do you mean by Commutation of a Thyristor? [2]
- b) A half-wave phase-controlled rectifier uses single thyristor and a purely resistive load. If its delay angle is:  $\alpha = \frac{\pi}{2}$ , determine: [5]
- (i) Rectification efficiency      (ii) Form factor      (iii) Ripple factor  
(iv) TUF      (v) PIV of the thyristor
11. Explain the working principle of buck-boost regulator with circuit diagram, expressions and waveforms. [8]

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 2078 Kartik

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1. Explain the operation of current steering circuit with necessary circuit diagram and its application. What are the advantages of amplifier using active load than using passive load in IC? [5+2]
2. Discuss noise in op-amp circuit with necessary diagram and suggest the measures to be taken to minimize internal noise. [7]
3. An amplifier using an op-amp with a slew rate  $SR = 0.92 \text{ V}/\mu\text{sec}$  has a gain of 38 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. Explain the working of Flash type ADC with its advantages and disadvantages? [7]
5. Derive the expression for output voltage of Binary weighted DAC. List out merits of R-2R ladder current mode DAC. [5+2]
6. Derive voltage gain of single op-amp Instrumentation amplifier with non zero source resistance with source resistance matching condition. [7]
7. Derive output voltage expression of log amplifier using matched transistor with op-amp offset voltage nullifying circuit diagram. [7]
8. Implement analog multiplier, analog divider and square root circuit using log and antilog amplifier. [3+3+2]
9. In an SCR halfwave rectifier, the forward breakdown voltage of SCR is 110V for gate current of 1 mA. If a 50 Hz sinusoidal peak voltage of 220 V is applied, find firing angle, conduction angle, average voltage, average current, average power output and the time during which SCR remains off. Assume load resistance is  $100 \Omega$  and the holding current to be zero. [2+1+1+1+1+2]
10. Define DC chopper. How can we step down DC voltage? Explain with necessary figures, waveforms and derivations. [1+6]
11. Explain the working of buck regulator with necessary circuit diagram, wave forms and derivations. [8]

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# ← 2078 Bhadra



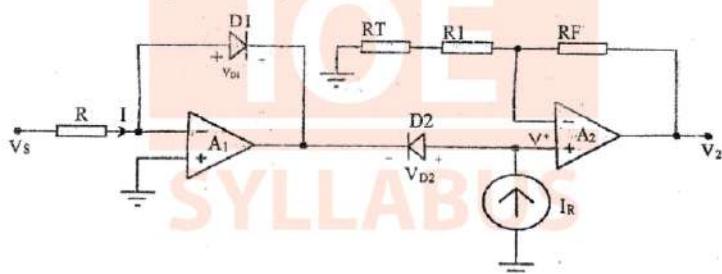
TRIBHUVAN UNIVERSITY  
INSTITUTE OF ENGINEERING  
**Examination Control Division**  
**2078 Bhadra**

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1. Why differential amplifier is used? Show that the output of a BJT based differential amplifier is directly proportional to the difference between two input voltages. [1+6]
2. Derive closed loop output impedance of non-inverting op-amp configuration. [7]
3. Define slew rate and input bias current of op-amp. An inverting op-amp configuration having gain of 1000 has saturation O/P voltage level  $\pm 10V$ . It has input offset voltage of 3mV. How much peak value of sine wave can be applied to input of op-amp to get undistorted output? [3+4]
4. Explain the working principle of Dual slope analog to digital converter and state its advantages and disadvantage. [7]
5. Explain the dynamic characteristics of DAC. Determine how many bits a DAC must have to provide output increment of 0.04V or less provided  $V_{ref} = 10 V$ . [3+4]
6. Derive the gain for the instrumentation amplifier using two operational amplifiers. Explain the optically coupled isolation amplifier. [4+3]
7. Derive the relationship between  $V_s$  and  $V_2$ . [8]



8. How four quadrants multiplier differs from single quadrant multiplier? Derive output voltage of four quadrants multiplier with necessary diagrams. [1+6]
9. Explain about working of single phase full bridge inverter with necessary circuit diagram, waveforms and derivations. [8]
10. Explain the working principle of Silicon controlled Rectifier with characteristics curve. Describe the SCR full wave rectifier circuit with waveforms. [4+3]
11. Derive expression for average output voltage, average output current, peak to peak output ripple voltage of Boost regulator with necessary circuit diagrams and waveforms. [8]

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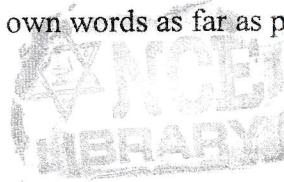


TRIBHUVAN UNIVERSITY  
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 2076 Ashwin

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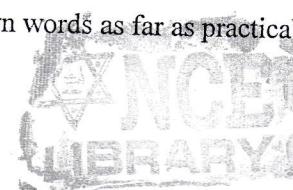
1. Why are current mirrors important in IC design? Describe how it is possible to obtain an output current that is twice the amount of reference current by using a current mirror circuit? [2+5]
2. Find the closed loop input impedance of an inverting op-amp. An inverting op-amp with  $R_f=330\text{K}\Omega$  and  $R_i= 10 \text{ K}\Omega$  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 a remedy. [2+5]
3. Explain the gain-bandwidth product of a practical op-amp. Find the output resistance of an amplifier that uses a practical op-amp. [2+5]
4. Design a 4-bit voltage mode R-2R ladder type DAC and derive the expression for its analog output. Differentiate between unipolar and bipolar DACs. [5+2]
5. State the application of sigma-delta ADC. In an 8-bit Dual slope ADC,  $R=20 \text{ K}\Omega$  &  $C=0.01\mu\text{F}$ , an analog signal of  $-0.25\text{V}$  is integrated for  $160 \mu\text{s}$ . What is the maximum voltage for  $160\mu\text{s}$ . What is the maximum voltage reached in the integration? If the counter is clocked at  $3.125\text{MHz}$ , what is the digital output after conversion? [2+5]
6. Find the condition required to reject common mode signal in a single op-amp instrumentation amplifier with matched resistor. List the applications of isolation amplifiers. [5+2]
7. Draw the circuit for logarithmic amplifier using matched transistor and find its transfer function. [5]
8. Design a circuit that produces the following output voltage:  $V_o = \sqrt{(V_1)^2 - 4(V_2)(V_3)}$ . How does four quadrant multiplier differ from single quadrant multiplier? [5+2]
9. Explain the working principle of SCR utilizing two transistor model along with its IV curve. [7]
10. Classify chopper. Explain the principle of step-down chopper with RL load. [1+5]
11. Explain the working principle of Boost regulator with circuit, expressions and waveform. [7]
12. Write short notes on:
  - a) PTAT devices
  - b) Input bias and input offset currents.

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**Examination Control Division**  
 2076 Chaitra

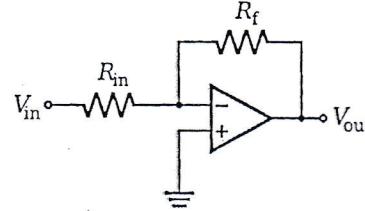
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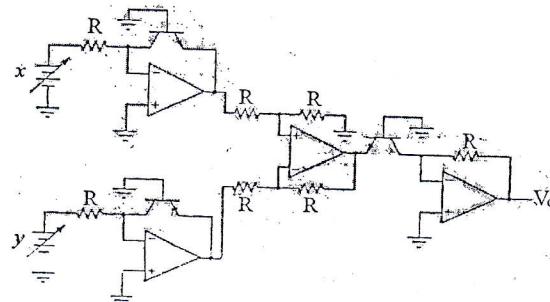
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1. a) Explain why active load is preferred in IC manufacturing. [3]  
 b) Show that a differential amplifier amplifies the difference of inputs but rejects common input.
2. For the inverting amplifier shown in figure below has  $R_{in} = 200K\Omega$  and  $R_f = 15 M\Omega$ . The op-amp used has input offset voltage = 4 mV, input bias current = 400 nA and input offset current = 150 nA. Calculate:
  - Maximum output offset voltage caused by the input bias current  $I_{B+}$ .
  - Maximum output offset voltage caused by the input voltage.
  - The value of compensation resistor  $R_{Comp}$  needed to reduce the effect of input bias current.
  - The maximum output offset voltage even if the  $R_{Comp}$  is connected in the circuit [2+2+1+2]



3. Why open loop op-amp configurations are not used in linear applications? Define frequency compensation on op-amp. Prove that gain bandwidth product is constant on op-amp. [2+2+4]
4. a) Why digital to analog converters are used to manufacture ADCs? [2]  
 b) Explain at least five specifications of A/D or D/A converter. [5]
5. Show that Dual slope ADC can cope with noises as well as temperature and clock variations but is extremely slow in terms of conversion time. [7]
6. Assuming source internal resistance are to be zero, design 3 Op-Amp Instrumentation amplifier having CMRR = 80 dB and common mode gain =  $10^{-2}$ . Draw the circuit diagram of optically coupled Isolation amplifier. [5+2]
7. Explain logarithmic amplifier using matched transistor with its transfer function and circuit diagram. [6]
8. Find output voltage. [8]



9. Explain the operation of Thyristor with construction and characteristics curve. Briefly explain about thyristor turn OFF method. [5+3]

10. Explain the working of single phase Half bridge inverter with necessary derivation and figures. [7]

11. A buck-boost regulator has an input  $V_s = 12V$ . the duty cycle  $K = 0.25$  and the average load current  $I_a = 1.25 A$ . The switching frequency is 25 KHz. If  $L = 150 \mu H$  and  $C = 220 \mu F$ , determine: [8]

- Average output voltage  $V_a$
- The ripple current of inductor,  $\Delta I$
- The peak current of transistor  $I_p$
- The peak to peak output ripple voltage,  $\Delta V_c$
- The critical value of  $L$  and  $C$

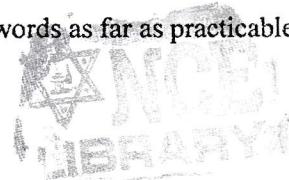
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2075 Ashwin

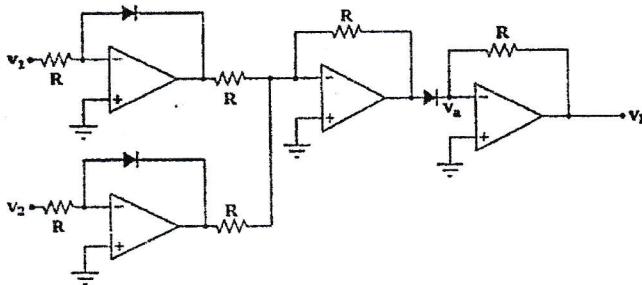
Exam.	.....	Back	.....
Level	BE	Full Marks	80
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Year / Part	III / I	Time	3 hrs.

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

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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  $R_i = 10K$  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
- Purely Inductive having inductance of 80mH and
  - 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:
- Duty cycle
  - Filter inductance
  - Filter capacitance
  - Critical values of L and C
- [1+2+2+2]
11. Write short notes on: (Any two)
- [5+5]
- Differential amplifier with active load
  - Isolation amplifier
  - Biasing circuit in IC Design

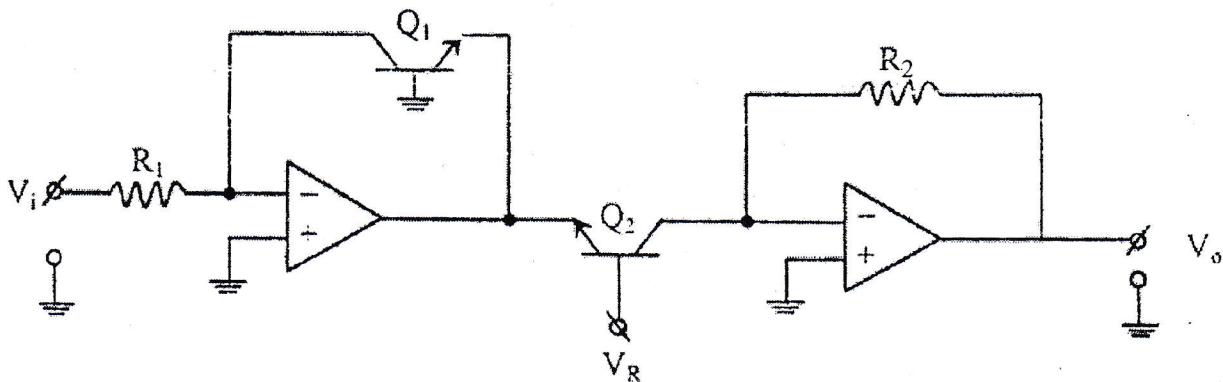
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1. What are the benefits of Widlar current source as compared to simple current source?  
 Derive an expression for an output resistance of Widlar Current Source. [3+5]
2. Show the effect of input offset voltage in Op-Amp. How can it be minimized? Define power supply rejection ratio of Op-Amp. [3+3+2]
3. An amplifier using an op-amp with a slew rate  $SR = 1V/\mu\text{ sec}$  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,  $V_{ref} = 100\text{mv}$  with 1000 clock pulses set for  $T_1$ . 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  $V_o$  and  $V_i$ . [4]



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]
- i) Firing angle
  - ii) Conduction angle
  - iii) Average current, assume load resistance =  $100\Omega$
  - iv) 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  $L = 0.1\text{nH}$  filter capacitance  $C = 0.2\text{nF}$  and average load current  $I_a = 1200\text{mA}$ . Determine: [2+2+3]
- i) The average output voltage
  - ii) Peak to peak output ripple voltage
  - iii) Peak to peak output ripple current
12. Write short notes on: (any one) [3]
- i) Differential amplifier with Active Load
  - ii) Generation of RMS output of sinusoidal wave using log antilog application

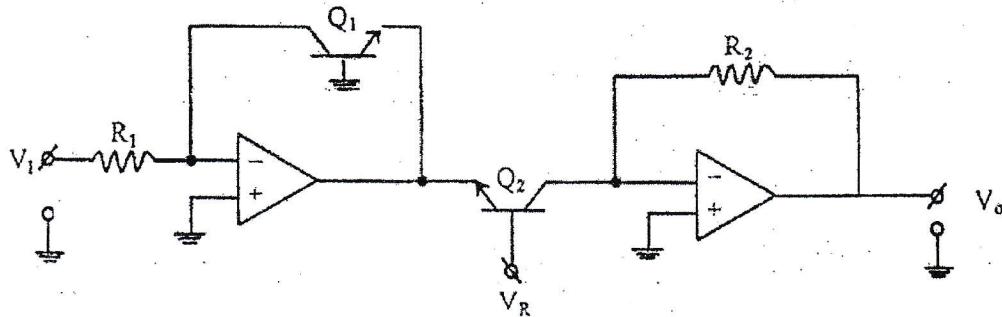
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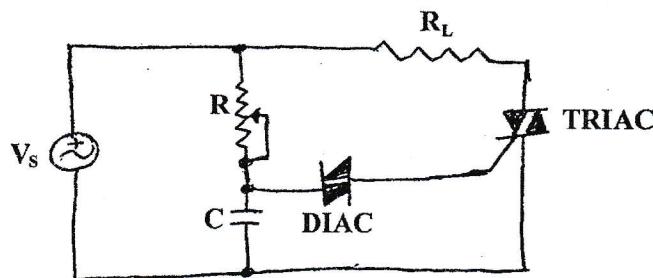
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1. What is a Current Mirror and its advantages? Find the output resistance of Widlar Current Source. [3+5]
2. Explain Slew rate of an Op-Amp with necessary expressions. Prove that the Gain Bandwidth Product of Op-Amp is Constant. [3+5]
3. Define input 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 of 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]

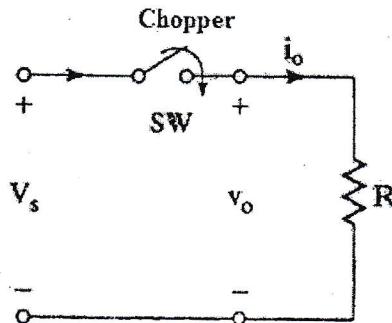


8. Explain the two transistor analogy of SCR with necessary mathematical expression. In the TRIAC firing circuit the parameter are input voltage ( $V_s$ ) = 230V, 50Hz, DIAC breakdown voltage is 25V,  $C = 0.6\mu F$ ,  $R$  can be varied from  $2000\Omega$  to  $20000\Omega$ . Find the minimum and maximum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

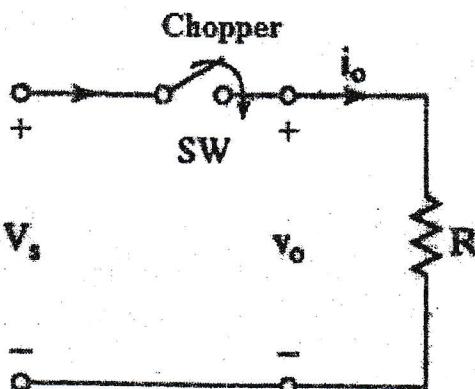
2073 Shrawan

Exam.	New Back (2066 & Later Batch)		
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- ✓ 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  $0.1\sin(200000t)\text{V}$ , 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 copper shown in figure below has a resistive load  $R = 10\Omega$ , the input voltage is  $V_s = 220\text{V}$ , when the copper 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.



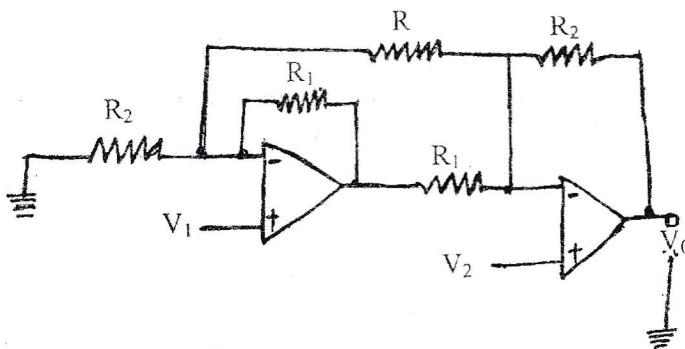
11. Explain the operation of Buck regulator with necessary diagram and derivation. [7]
12. Explain (any one)
  - i) Differential Amplifiers
  - ii) Process of RMS detection of Sine wave using log-antilog applications

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

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

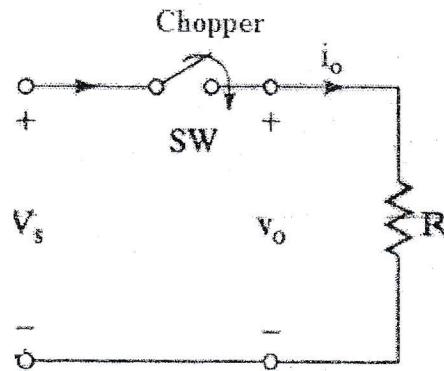
- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ Attempt All questions.
- ✓ The figures in the margin indicate Full Marks.
- ✓ Assume suitable data if necessary.

1. List out the basis requirement of current mirror circuits. Derive and express the output resistance of Widlar current source. Which one is best current source and why? [2+4+1]
2. Define Slew rate of OP amp. An inverting configuration op amp has feedback resistor  $470\text{ k}\Omega$  and input resistor  $10\text{ k}\Omega$ . If input signal is  $0.1\sin(20000t)\text{V}$ , 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. What is input offset voltage, and input offset currents of an operational amplifier? How the effect of input bias currents can be compensated in operational amplifier? [2+5]
4. List out the advantages of bipolar D/A converter over Binary weighted resister. Express output voltage of bipolar D/A converter. What happens when input is 0000, 1000 and 1111? [2+4+1]
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. Write down the application of isolation amplifier. Draw a circuit diagram for a optically coupled isolation amplifier. [2+2]
7. Calculate the output voltage for the 2 op-amp Instrumentation amplifier circuit shown in figure below. [4]



8. Derive transfer function of antilog amplifier using match transistor. [5]
9. Why log antilog amplifier circuits are required? Draw the circuit diagram of antilog multiplier and explain it. [2+4]
10. Explain the working principle of Silicon Controlled Rectifier, utilizing two transistor model with its VI curve. [7]

11. What are inverters? 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 copper 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+1+2+2]
- The average output voltage
  - The RMS value of output voltage
  - The copper efficiency



12. Explain the working principle of Boost regular with necessary circuit, waveforms and expressions. [7]
13. Write short notes on: (any one) [5]
- Current Steering Circuits
  - Generation of RMS output of Sinusoidal wave using log antilog application

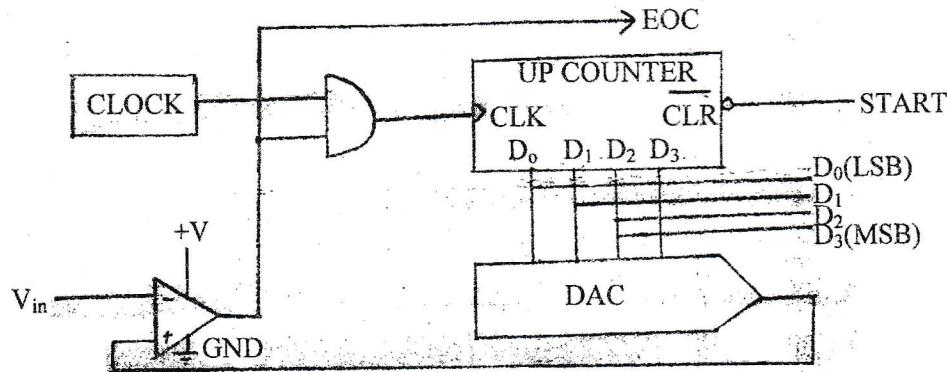
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Exam.	New Back (2066 & Later Batch)		
Level	BE	Full Marks	80
Programme	BEX	Pass Marks	32
Year / Part	III / I	Time	3 hrs.

**Subject:** - 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. Why output current of simple mirror circuit is not exactly equal to reference current?  
Derive the output resistance of widlar current source? [2+5]
2. Prove that Gain Bandwidth Product of operational amplifier is constant. [4]
3. Draw a circuit diagram of inverting op-amp and derive the expression of input impedance. [5]
4. Show that the input bias currents affect the output voltage of op-amp with necessary diagram. Also, discuss about the ways to mitigate the problem. [5]
5. For the ADC shows below, the full scale output voltage ( $V_{FS}$ ) = 12.00V. The clock PRF is 10KHz. Determine: [2+2+3]
  - i) Maximum and minimum conversion time
  - ii) Resolution
  - iii) The output count and the conversion time for  $V_{in} = 4.25V$

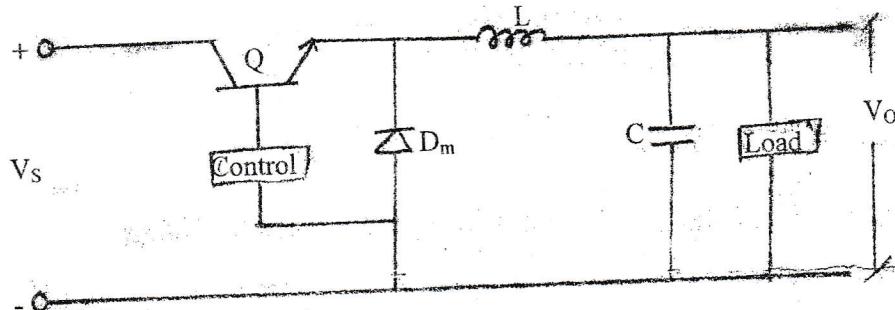


6. Why current mode R-2R ladder type DAC is preferred over voltage mode R-2R ladder type DAC? Find expression for output voltage of Bipolar DAC and justify its name. [2+5]
7. What is an instrumentation amplifier? What are its characteristics? Derive the necessary relation to find the input impedance and output voltage in case of single op-amp instrumentation amplifier with mismatched resistance. [1+1+5]
8. Draw the circuit diagram of a basic logarithmic amplifier and explain it. [4]
9. Construct and explain the multiplier circuit using log and antilog amplifier and hence use the multiplier to realize the divider circuit. [7]
10. Describe two transistor models of SCR and illustrate its characteristic curve. [3+3]

11. A SCR used in half-wave controlled rectifier is fired at the angle of  $30^\circ$ . Input voltage for the rectifier is  $50 \sin(2\pi 50t)$  and the load resistance is  $100\Omega$ . Find average load voltage, rms load voltage, efficiency and ripple factor for the rectifier. [8]

12. For the Buck regulator if input voltage  $V_s = 12V$ , the required average output voltage is  $6V$  at  $R = 450$  ohm and peak to peak output ripple voltage is  $20$  mV, switching frequency is  $20$  KHz and peak to peak ripple current of inductor is  $0.8A$ , find: [2+2+3]

- i) Duty cycle
- ii) Filter capacitance C
- iii) Filter inductance L



[3+3]

13. Write short notes on:

- i) Working principle of TRIAC
- ii) Define the terms CMRR, PMRR and Slew Rate

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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  $1\text{ K}\Omega$  and  $33\text{ K}\Omega$  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  $f = 1\text{ kHz}$  and slew rate =  $0.6\text{ V}/\mu\text{s}$ . (ii) If the value of  $V_p$  is assumed to be  $5\text{V}$ , 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 ( $V_{FS}$ ) =  $16.00\text{V}$ . The minimum conversion time is  $0.1\text{ms}$ . Determine: [2+3+3]

- PRF of clock used
- Resolution
- The Digital output and the conversion time for  $V_{in} = 6.25\text{V}$

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]

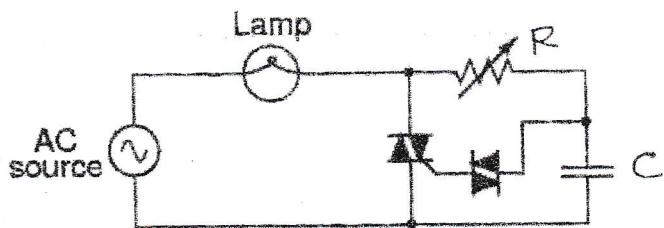
8. Construct a circuit that generates square root of an input voltage and derive its input-output relationship. Draw a circuit that produces the output voltage  $V_o = \sqrt{(V_1 \cdot V_2)^2 + (V_3 \cdot V_4)^2}$  [3+4]

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]

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

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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:** - 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 benefits of widlar current sources as compared to a simple current mirror?  
Derive an Expression for an output resistance of widlar current source. [2+5]
2. Define input offset voltage. For a given op-amp, prove that gain-bandwidth-product (GBP) is constant. [2+5]
3. In a closed-loop inverting configuration of an op-amp, the input resistance and the feedback resistance are  $1K\Omega$  and  $33K\Omega$  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/ $\mu$ s. (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]
4. Draw and explain the circuit diagram of flash type ADC. What are the demerits of flash type ADC over other ADC's? [3+3+1]
5. Explain the operation of Bipolar DAC. Write disadvantages of Weighted Resistor DAC. [5+2]
6. Determine the condition required to reject common mode signal in a single op-amp instrumentation amplifier with mismatched resistor. List out the applications of isolation amplifiers. [5+2]
7. Draw the circuit for the logarithmic amplifier using matched transistor and find its transfer function. [5]
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  $V_o = \sqrt{(V_1.V_2)^2 + (V_3.V_4)^2}$  [3+4]
9. Explain the two transistor analogy of SCR with necessary mathematical expression. For the half-wave controlled rectifier with a load  $R=50\Omega$ , input voltage is a 120v-rms ac voltage. Assume that the drop across the SCR is 1.5v when it is conducting. (a) What should be the firing angle if it is desired to deliver an average current of 1A to the load? (b) What is the average power delivered to the load under the condition of (a)? [4+2+2]
10. Explain the working of a step-down chopper with RL load with necessary derivations and Diagram. [6]
11. A boost regulator has an input voltage of  $V_s = 5V$ . The average output voltage  $V_a = 15V$  and average load current  $I_a = 0.5$  A. The switching frequency is 25 KHz. If  $L = 150 \mu H$  and  $C = 220 \mu F$ . Determine (i) Duty cycle (ii) The peak current of inductor  $I_2$  (iii) Ripple voltage of filter capacitor  $\Delta V_c$  and (iv) Critical value of L and C. [1+2+2+2]
12. Show that the differential amplifier with active load has higher voltage gain than with passive load. [5]

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**Examination Control Division**  
2071 Chaitra

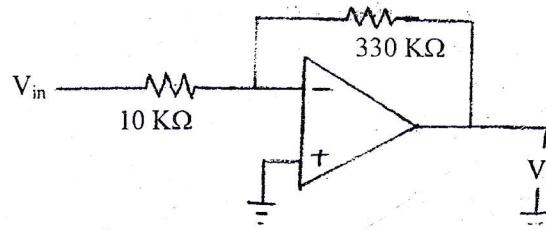
Exam.	Regular		
Level	BE	Full Marks	80
Programme	BEX	Pass Marks	32
Year / Part	III / I	Time	3 hrs.

**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 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 wider 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]

$$\begin{aligned}V_1 &= .01 \sin 10^6 t \\V_2 &= .05 \sin (350 \times 10^3) t \\V_3 &= .1 \sin (200 \times 10^3) t \\V_4 &= .1 \sin (50 \times 10^3) t\end{aligned}$$

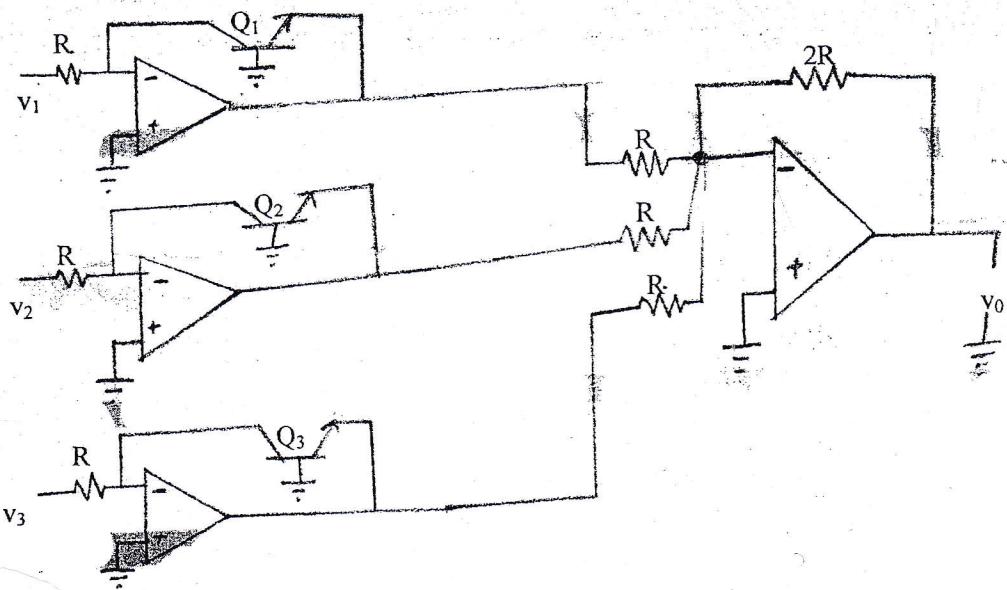


Determine whether the output will get distorted due to slew rate limitation? Find the new value of feedback resistor such that none of the signal gets distorted.

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 1V, 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:  
 a) Application of Log and Antilog Amplifier  
 b) SMPS [3+3]

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**Examination Control Division**

2070 Ashad

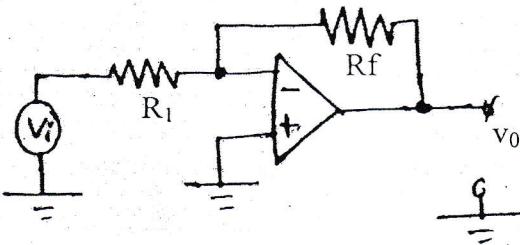
Exam.	New Back (2066 & Later Batch)		
Level	BE	Full Marks	80
Programme	BEX	Pass Marks	32
Year / Part	III / I	Time	3 hrs.

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

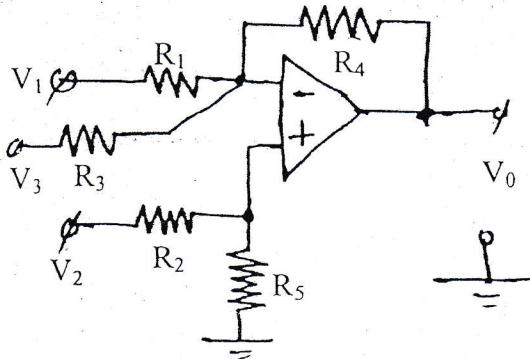
- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ Attempt All questions.
- ✓ The figures in the margin indicate Full Marks.
- ✓ Assume suitable data if necessary.

1. What is the principle of biasing the circuit in IC design? Write the advantages of Widlar current source. Derive the differential mode voltage gain for BJT differential amplifier. [2+1+4]
2. For the inverting amplifier shown in figure below,  $R_1 = 100 \text{ k}\Omega$  and  $R_f = 10 \text{ M}\Omega$ . Calculate:
  - i) Maximum output offset voltage caused by the input bias current  $I_B$
  - ii) Maximum output offset voltage caused by the input offset voltage,  $V_{ios}$ .
  - iii) The value of compensation resistor  $R_{comp}$  needed to eliminate the effect of input bias current
  - iv) The maximum output offset voltage even if the  $R_{comp}$  is connected in the circuit.

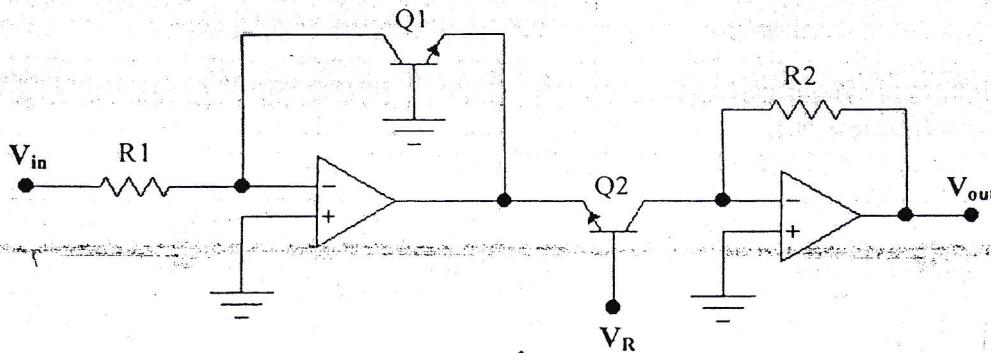
The op-Amp used is 741 with  $V_{ios} = 6 \text{ mV}$ ,  $I_B = 500 \text{ nA}$  and  $I_{os} = 200 \text{ nA}$



3. Explain gain-bandwidth product of a practical opamp. Determine the output resistance of an amplifier that uses a practical opamp. [2+5]
4. Design a 4 bit voltage mode R-2R ladder type digital to analog converter and derive the expression for its analog output. Also differentiate between unipolar and bipolar DACs. [5+2]
5. State the application of sigma delta ADC. In an 8-bit Dual Slope ADC,  $R = 20 \text{ k}\Omega$  and  $C = 0.001 \mu\text{F}$ . An analog input signal of  $-0.25 \text{ V}$  is integrated for  $t_1 = 160 \mu\text{s}$ . What is the maximum voltage reached in the integration? If the counter is clocked at  $3.125 \text{ MHz}$  what is the digital output after the conversion? [2+5]
6. For the circuit shown in figure below, the output voltage can be expressed as  $V_0 = a_1 V_1 + a_2 V_2 + a_3 V_3$ . Now : (i) Find the value of  $a_1$ ,  $a_2$  and  $a_3$ . Also find the value of  $v_0$  if (ii)  $R_4$  is short circuited and (iii)  $R_4$  is removed. [3+2+2]

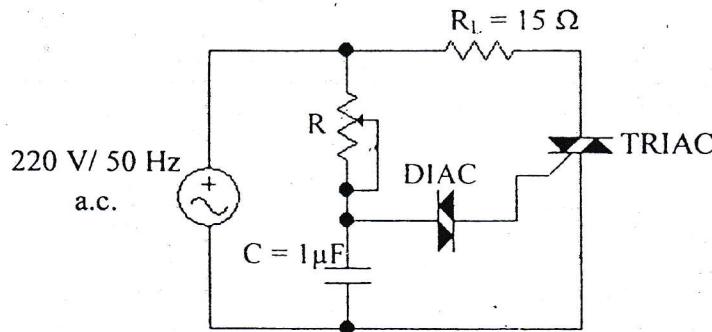


7. Find the expression for  $V_0$  in terms of  $V_{in}$  and  $V_R$  for the circuit given below. Transistors  $Q_1$  and  $Q_2$  are matched transistors. [4]



8. How a multifunction converter can be constructed using log and antilog amplifiers? Explain with circuit realization. [7]

9. In the light dimmer circuit shown in figure below, find the minimum and maximum possible conduction angles. Draw the voltage waveform across the load for both cases. Also compute the average power delivered to the load at maximum conduction angle. [3+2+2]



Variable resistor  $R$  can be varied from  $2 \text{ k}\Omega$  to  $20 \text{ k}\Omega$  and break over voltage for diac is 12V.

10. Explain the operation of single phase full bridge inverter with necessary figures. What are the methods of controlling output power in dc- to- dc conversion? [5+2]

11. Derive the relation of average output voltage with input voltage in boost regulator with necessary circuit diagram and wave forms. Briefly explain about switch mode power supply with block diagram. [4+3]

12. Write short notes on: [3x2]

- Instrumentation Amplifier
- Noise in opamp circuit

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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]

(3)

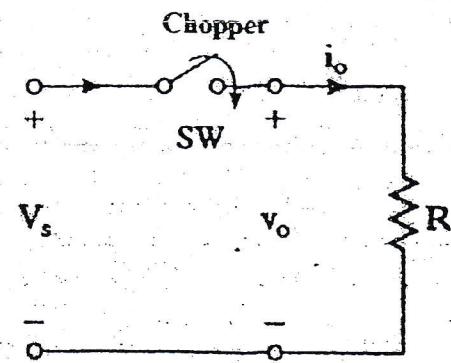
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New Back (2066 & Later Batch)			
Exam.	Level	Full Marks	80
	BEX	Pass Marks	32
	Year / Part	III / I	Time 3 hrs.

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. Draw a current mirror circuit and determine the expression for output current. Explain the effect of finite  $\beta$  and finite output resistance on output current of a current mirror circuit. [1+2+2+2]
2. Draw the waveform of output voltage of voltage follower operational amplifier having square wave as input signal with peak-to-peak voltage of 2V and frequencies (i) 100Hz and (ii) 100KHz. Assume that op-amp has slew rate of  $0.5V/\mu s$ . Label the waveform neatly illustrating timing and amplitude details. [3.5+3.5]
3. What are input offset voltage and input offset currents of an operational amplifier? How can we reduce the effect of input bias currents in operational amplifier? [2+5]
4. Determine the output voltages caused by each bit in a 4 bit voltage mode R-2R ladder if the input levels are '0'=0V and '1'=+12V. Determine the resolution and full scale output of this ladder circuit and also find out the voltage from the above ladder for a digital input of 1011. [2+2+1+2]
5. Compare performance of successive approximation and flash type A/D converters in terms of resolution, conversion time and cost. [7]
6. What are the features of instrumentation amplifier? Design a three op-amp instrumentation amplifier having gain 20. [2+5]
7. Obtain the output voltage relationship of an antilog amplifier using two matched transistor and two op-amps. [6]
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. Explain the working principle of thyristor along with IV curve. [7]
10. For the chopper shown below with 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  $f=1kHz$  with duty cycle of 50%. Determine: [2+2+3]
  - a) The average output voltage
  - b) The RMS value of output voltage
  - c) The chopper efficiency



11. Describe the working of Buck regulator with necessary circuits and derivations. [3+4]
12. Why active load is preferred than passive load? What is the advantage of using Widlar current source in biasing circuits for IC design? [2+2]

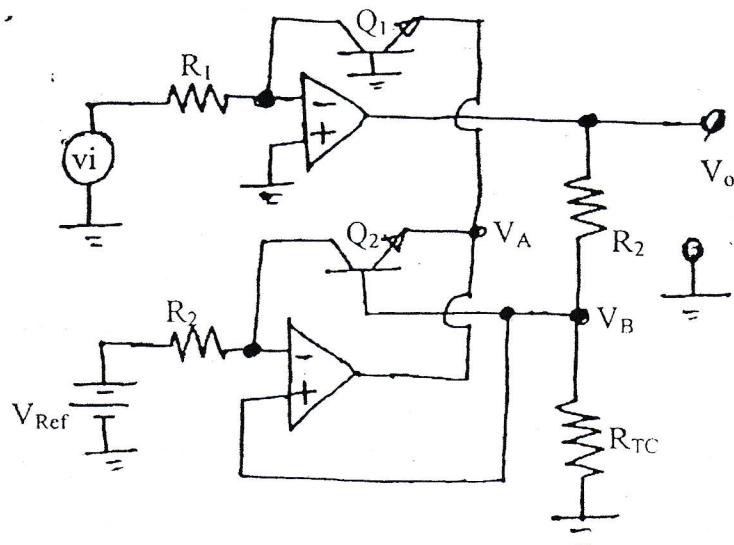
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Exam.	Regular		
Level	BE	Full Marks	80
Programme	BEX	Pass Marks	32
Year / Part	III / I	Time	3 hrs.

**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 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  $470\text{ K}\Omega$  and an 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 opamp. If so, find a remedy. The opamp has a slew rate of  $0.5\text{V}/\mu\text{s}$ . [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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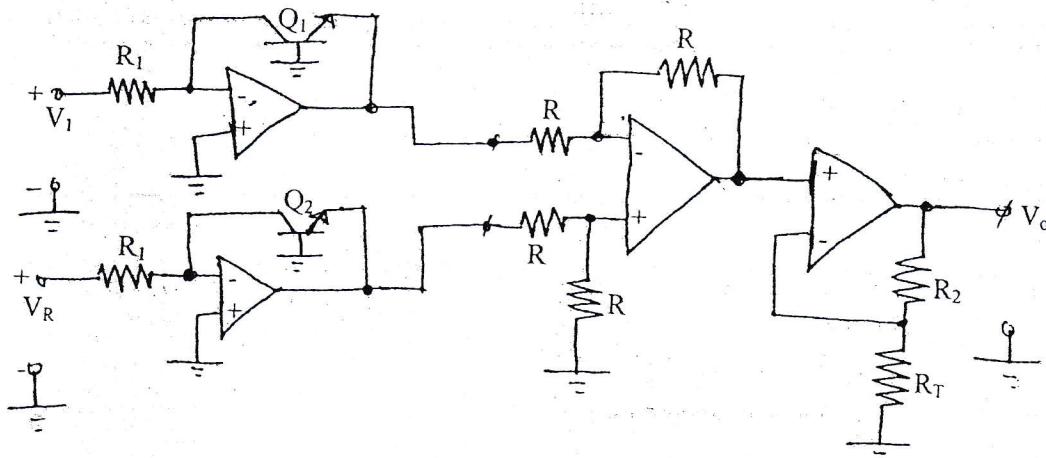
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1. What are the essential conditions for a current mirror to work? Derive an expression for an output resistance of Widlar Current Source. [2+5]
2. Define Slew Rate of an operational amplifier. An amplifier has a bandwidth of 20KHz and closed loop 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. [2+5]
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? [7]
5. Explain the operation principle of count up/down and tracking type ADC with necessary diagram. [5+2]
6. Find the expression for output voltage of three op-amp instrumentation amplifier. Also, explain how it rejects common mode signal. [7]
7. Find expression of output voltage for the circuit shown in figure below. ( $Q_1$  and  $Q_2$  are matched transistors). [5+2]

[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]

- a) Firing angle
- b) Conduction angle
- c) Average output voltage
- d) 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]

- a) Differential Amplifier
- b) Applications of log-antilog amplifier.

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