C 3181

B.E./B.Tech. DEGREE EXAMINATION, MAY/JUNE 2007.

Fourth Semester

(Regulation 2004)

Electronics and Communication Engineering

EC 1254 — LINEAR INTEGRATED CIRCUITS

(Common to B.E. (Part–Time) Third Semester Regulation 2005)

Time : Three hours   Maximum : 100 marks

Answer ALL questions.

PART A — (10 × 2 = 20 marks)

1. Calculate the output current I of the current source given in Fig. 1. Assume h_{FE} of transistor is very high and $V_{BE} = 0.6V$.
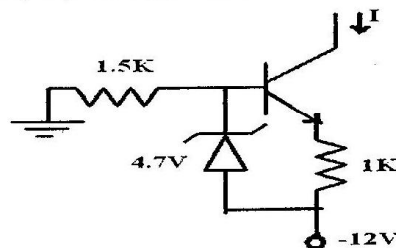

Fig. 1

2. Draw the circuit of a Widlar current source and write the expression for its output current.

3. Two voltages $+V_1$ and $+V_2$ are available. Using two operational amplifiers draw a circuit to compute $5 V_1 - 3 V_2$.

4. Calculate the current I in the circuit shown in Fig.2.
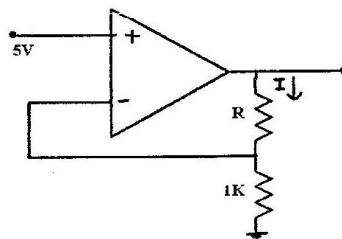

Fig. 2

5. Explain how a frequency doubler can be realized using analog multiplier.

6. A PLL with a free running frequency of 1 KHz is connected to a variable frequency oscillator. The frequency of oscillator is gradually increased and when its frequency was 850 Hz the PLL got locked. The frequency of oscillator was decreased and it went out of lock for the oscillator frequency of 800 Hz. Calculate the lock range and the capture range of the PLL.

7. The input to a sampling gate is a sine wave. Plot its output with and without a hold capacitor.

8. State the reason for keeping the integrating time in the dual slope analog to digital converter equal to that of mains supply period.

9. In a linear voltage regulator, the input voltage is 20 V and output voltage is 15 V. For a load current of 1 Ampere, calculate the power dissipated in the series pass element.

10. Draw the internal diagram of an optocoupler.

PART B — $(5 \times 16 = 80 \text{ marks})$

11. (a) (i) Draw the circuit of a simple bipolar transistor current source and show that its output current is dependent on the β of the transistor. (8)

     (ii) Explain how the above circuit can be modified to make it less insensitive to β. (8)

Or

   (b) Draw the circuit of a differential amplifier with current mirror load. Draw its equivalent circuit and derive an expression for its gain. (16)

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12. (a) (i) In the circuit given in Fig. 3, show that the input resistance
$R_i = \dfrac{V_i}{I_i} = \dfrac{R_1 \cdot R_3}{R_3 - R_1}$. (8)

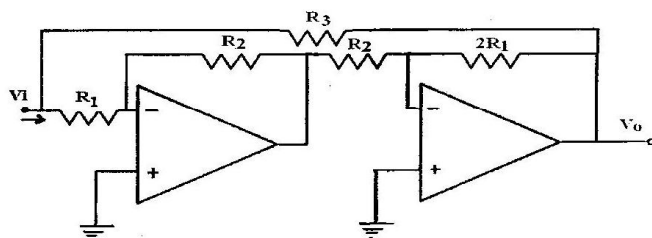

Fig. 3

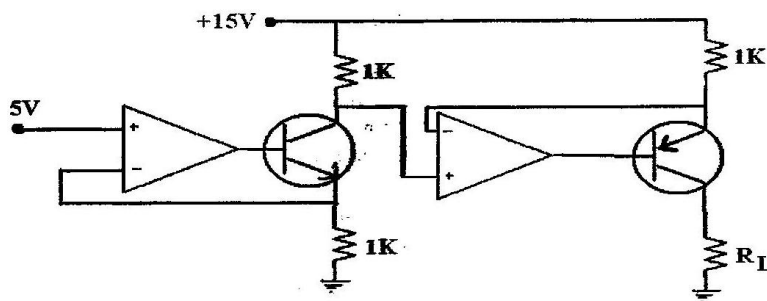(ii) Calculate the current through R_1 in the circuit shown in Fig 4. (8)

Fig. 4

Or

(b) (i) Draw the circuit diagram of a second order Butterworth active lowpass filter and derive an expression for its transfer function. (10)

(ii) Design the above mentioned filter for a cutoff frequency of 1 KHz and a damping factor of 1.4. (6)

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13. (a) (i) With circuit diagram explain the working of variable transconductance multiplier. What is its limitation? (10)

   (ii) Explain how a multiplier can be modified as square root extractor. (6)

Or

(b) (i) Draw the block diagram of a PLL and derive its transfer function. (10)

   (ii) Draw the circuit of FM demodulator using PLL. (6)

14. (a) (i) Draw the circuit of a R-2R ladder type digital to analog converter and explain. (8)

   (ii) Draw the circuit of a four bit R-2R D/A converter with feedback resistance of 3R for the Op-Amp. Calculate its output voltage for a digital input of 0100 if the reference voltage is 2.5 V. (8)

Or

(b) (i) Explain the working of flash analog to digital converter. (8)

   (ii) How many comparators are required for a 4- bit flash ADC? For an input signal in the range of 0 to +10 V. What are the reference voltages needed? Show how they can be generated using a 10 V reference and several 1 Kohm resistors. (8)

15. (a) (i) Draw the internal block diagram of voltage regulator IC LM 723 and explain. (8)

   (ii) Design a voltage regulator using LM 723 with short circuit current protection for the following specifications. V_o = 12 V, I_L = 500 mA, Isc = 600 mA. (8)

Or

(b) Draw the circuit of an IC tuned amplifier and explain how you will realize RF amplifier with AGC and a video amplifier using this building block. (16)