Name : .....

Roll No. : .....

Invigilator's Signature : .....

2010

ANALOG INTEGRATED CIRCUITS

Time Allotted : 3 Hours | Full Marks : 70

The figures in the margin indicate full marks.

Candidates are required to give their answers in their own words as far as practicable.

GROUP – A
(Multiple Choice Type Questions)

1. Choose the correct alternatives for any *ten* of the following : $10 \times 1 = 10$

   i) An ideal Op-Amp has CMRR and slew rate respectively

      a) infinity and infinity b) zero and infinity

      c) zero and zero d) infinity and zero.

   ii) Astable multivibrator uses

      a) positive trigger

      b) negative trigger

      c) both positive & negative triggers simultaneously

      d) no trigger at all.

iii) In an Op-Amp integrator circuit

a) a highly resistive feedback path is used

b) a capacitive feedback path is used

c) no feedback is at all used

d) none of these.

iv) Integrator is also called

a) low-pass filter b) high-pass filter

c) band-pass filter d) band-gap filter.

v) The centre frequency of a band-pass filter is always equal to the

a) bandwidth

b) geometric average of the cut-off frequency

c) bandwidth divided by 2

d) 2 dB frequency.

vi) In case of monostable operation using 555 timer, the formula for the pulse width is given as

a) $W = 1{\cdot}1\ RC$ b) $W = 0{\cdot}693\ (RC)$

c) $W = i/0{\cdot}693\ (RC)$ d) $W = 1{\cdot}1/RC$

vii) The Wien-bridge oscillator is useful

a) at low frequency b) at high frequency

c) with LC tank circuit d) at small input signal.

viii) Schmitt trigger is a comparator using

a) negative feedback b) positive feedback

c) both (a) & (b) d) none of these.

ix) What is standard value of the resistor used in the feedback path of an Op-Amp based buffer circuit ?

a) 10 kΩ b) 100 kΩ

c) 1 MΩ d) none of these.

x) An Op-Amp cannot be used to implement

a) monostable multivibrator

b) bistable multivibrator

c) astable multivibrator

d) frequency doubler.

xi) An instrumentation amplifier is an improvement over

a) inverting amplifier b) non-inverting amplifier

c) differential amplifier d) voltage follower.

xii) An 8-bit DAC has a maximum output voltage of 2 V. If V_{in} = 1·5 V, the digital output at the end of conversion will be

a) 0001 1100 b) 0010 0011

c) 0110 0000 d) 1100 0000

xiii) Second order active filter with damping coefficient α = 1·414 is a

a) low-pass filter b) high-pass filter

c) Butterworth filter d) Bessel filter.

xiv) Which one is *not* an A/D converter circuit ?

a) Successive approximation type

b) Weighted register type

c) Dual slope type

d) Flash type.

xv) According to Barkhausen criteria in order to sustain the oscillations

a) loop gain of the circuit must be negligible

b) loop gain of the circuit must be equal to unity

c) the phase shift around the circuit must be 180 degree

d) none of these.

GROUP – B
(Short Answer Type Questions)

Answer any *three* of the following. $3 \times 5 = 15$

2. Define the following terms for an Operational Amplifier :

a) Input offset voltage

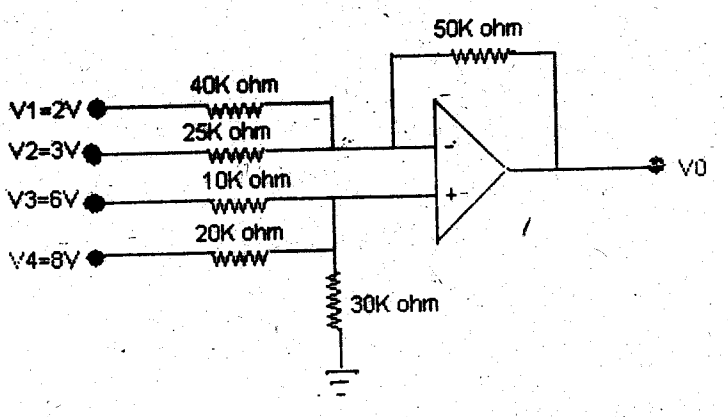
b) Input offset current

c) Slew rate

d) CMRR

e) Input resistance.

3. Find V_0 for the following circuit :



4. Draw the circuit of a subtractor using two Op-Amps and explain it.

5. Draw and explain a circuit that can be used to detect peak value of the non-sinusoidal waveforms.

6. What is the drawback of log amplifier ? How to overcome the drawbacks ?

GROUP – C
(Long Answer Type Questions)

Answer any *three* of the following. $3 \times 15 = 45$

7. a) Design a first order high-pass Butterworth filter at a cut-off frequency of 1 kHz with a pass band gain of 2. Derive the necessary working formula.

   b) Derive the slew rate equation for an Op-Amp.

   c) Design a differentiator to differentiate an input signal that varies in frequency from 10 Hz to about 1 kHz.

   If a sine wave of 1 V peak a Hz is applied to the differentiator, what will be the output voltage ?

   (4 + 2) + 3 + (3 + 3)

8. a) Draw and explain the working of Triangular wave generator using Op-Amp.

   b) Draw the circuit diagram of Antilog Amplifier and explain its operation.

   c) Explain how the operation of square rooting can be carried out using a multiplier IC. 5 + 5 + 5

9. a) Describe the principle of a R-2R ladder type digital to analog converter.

   b) Using LM 317, design an adjustable voltage regulator to satisfy the following specifications :

   Output voltage V_0 = 5 to 12 V

   Output current I_0 = 1 A

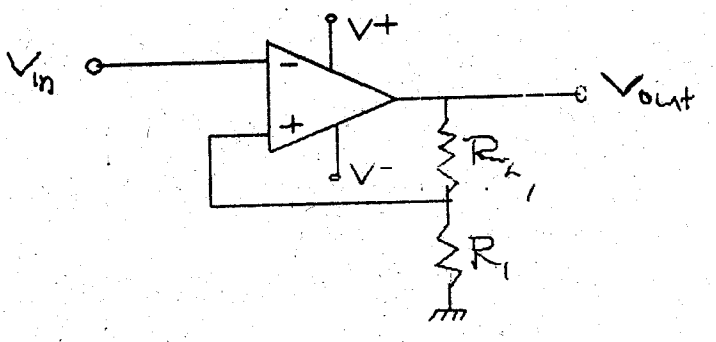
   c) In the astable multivibrator, R_A = 2·2 kΩ, R_B = 3·9 kΩ and C = 0·1 μF.

   Determine the positive pulse width t_c, negative pulse width t_d, free running frequency f_0 and % duty cycle.

   7 + 4 + 4

10. Explain the operation of an inverting Schmitt trigger circuit. For the inverting Schmitt trigger circuit shown in the figure, calculate R_2 if R_1 = 100 kΩ and hysteresis voltage width = 4 V.

   Assume saturation voltages to be + 14 V to – 14 V.



11. Write short notes on any *three* of the following : 3 × 5

a) IC 555

b) Instrumentation Amplifier

c) Sample and Hold circuit

d) Full-wave precision rectifier

e) Voltage to current converter.