Code : 041606

B.Tech 6th Semester Exam., 2016

INTELLIGENT INSTRUMENTS

Time : 3 hours   akubihar.com   *Full Marks* : 70

Instructions :

(i) *The marks are indicated in the right-hand margin.*

(ii) *There are **NINE** questions in this paper.*

(iii) *Attempt **FIVE** questions in all.*

(iv) *Question No. **1** is compulsory.*

1. Choose the correct option/Answer the following (any *seven*) :   2×7=14

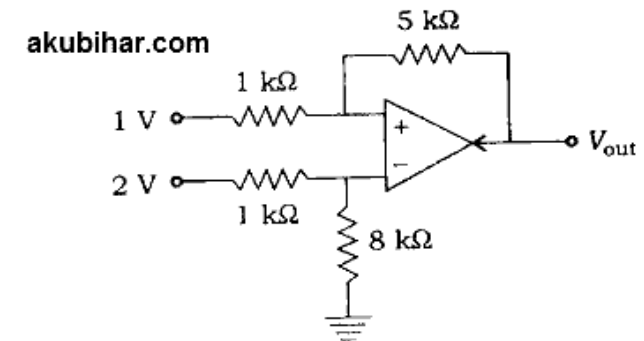   (a) If the op-amp (in Fig. 1) is ideal, the output voltage V_{out} will be equal to

   Fig. 1

   (i) 5·6 V   (ii) 6 V

   (iii) 14 V   (iv) 17 V

(b) In Fig. 2, capacitor is initially uncharged. At $t = 0$, switch S is closed. The voltage V_C across capacitor at $t = 2$ msec is
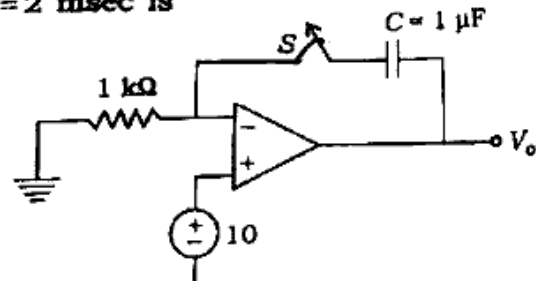

Fig. 2

(i) 0 V   (ii) 6·3 V

(iii) 9·45 V   (iv) 20 V

(c) In Fig. 3, the V-I characteristics of the diode is described by $I = I_o (e^{V/V_T} - 1)$ $V_T = 25$ mV, $I_o = 1\ \mu A$, V is the voltage across the diode. For an input voltage of -1 V, the output voltage is
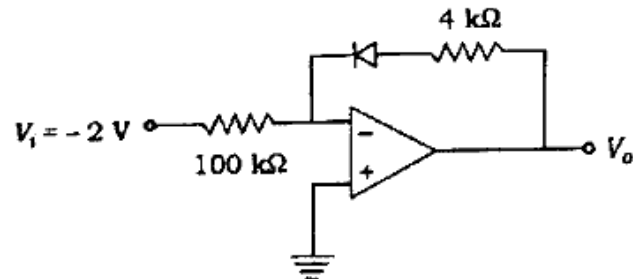

Fig. 3

(i) 0 V   (ii) 0·156 V

(iii) 0·7 V   (iv) 1·1 V

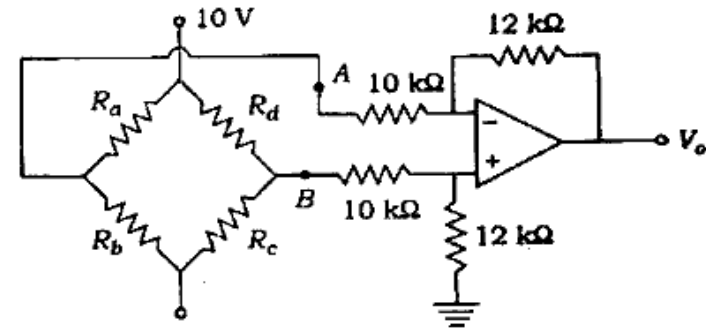(d) In Fig. 4, $R_c = R_a = R_b = R_d = 200\ \Omega$. Then o/p voltage is

Fig. 4

(i) 0 V

(ii) 10 V

(iii) 100 V

(iv) 120 V

(e) A 10-bit A/D converter is used to digitize an analog signal in the range 0 V to 10 V. The maximum peak-to-peak ripple voltage that can be allowed in the d.c. supply voltage is nearly

(i) 100 mV

(ii) 10 mV

(iii) 25 mV

(iv) 5 mV

(f) If the resolution of D/A converter is approximately 5% of its full-scale range, then it is an/a

    (i) 8-bit converter

    (ii) 10-bit converter

    (iii) 12-bit converter

    (iv) 16-bit converter

(g) The open-loop gain of an op-amp falls to zero decibel at 10 MHz. What is its unity gain crossover frequency?

    (i) 1 MHz

    (ii) 10 MHz

    (iii) 5 MHz

    (iv) Indeterminate from given data

    (v) None of the above

(h) Fig. 5 shows an op-amp voltage-follower circuit. This circuit is being driven by another circuit with output resistance of 100 kΩ. What should be the value of R?
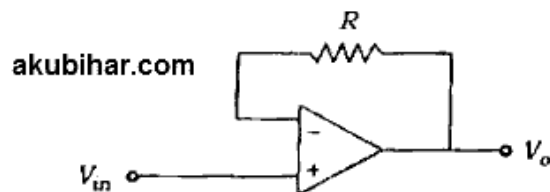

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Fig. 5

    (i) 100 kΩ   (ii) 0

    (iii) 10 kΩ   (iv) 1 MΩ

    (v) None of the above

(i) Capture range of a phase-locked loop is

    (i) equal to its lock range

    (ii) less or equal to lock range

    (iii) always greater than lock range

    (iv) greater or equal to lock range

    (v) None of the above

(j) Define narrow band-pass filter.

2. (a) Discuss the criteria for selecting a transducer.

    (b) Discuss the ideal op-amp's electrical characteristics.   7+7

3. (a) Draw the circuit diagram of practical integrator and derive the input-output relations for the same.

    (b) Discuss one application where instrumentation amplifier is used.   7+7

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4. (a) Discuss different features of instrumentation amplifier.

    (b) Design a low-pass filter having a cut-off frequency of 2 kHz with a pass-band gain of 2.   7+7

5. (a) For a 5-bit ladder type D/A converter, if the input levels are 0 = 0 V and 1 = + 10 V, what are the output voltages for each bit?

   (b) Discuss one method of D/A conversion with circuit diagram. 7+7

6. (a) Discuss about different pressure sensitive primary devices (transducers).

   (b) Draw the block diagram and operating principles of phase-locked loop. 7+7

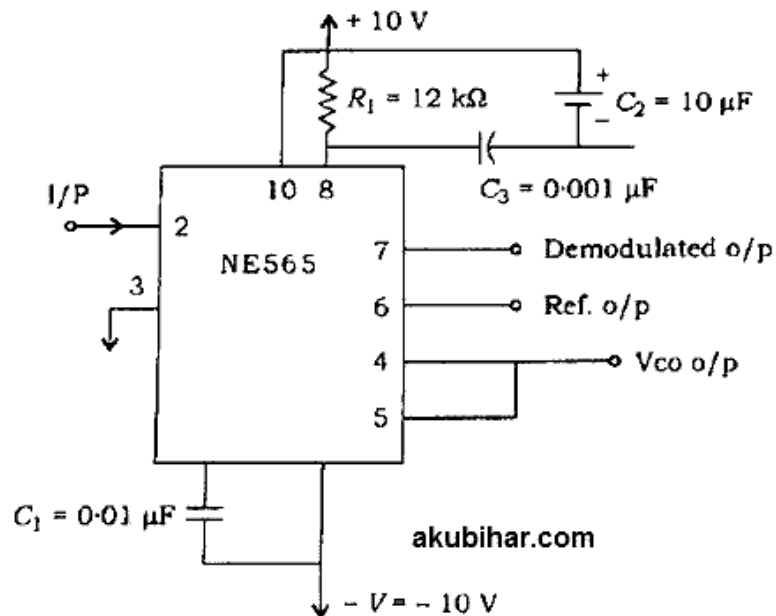7. (a) Determine the free-running frequency f_{out}, the lock range f_L, and the capture range f_C of Fig. 6 :

Fig. 6

(Continued)

   (b) How can voltage to current converter be used for diode match finder? 7+7

8. (a) Draw the circuit and discuss the working principles of Schmitt trigger.

   (b) Using $R_1 = 100\ \Omega$, $R_L = 56\ k\Omega$, $V_{in} = 1$ VPP sine wave and op-amp with supply voltage (± 15 V). Construct a Schmitt trigger circuit. Determine the threshold voltage V_{ut} and V_{lt} and draw the output waveform. 7+7

9. (a) Draw the block diagram of intelligent instrument and discuss its different blocks.

   (b) Draw the op-amp based sample and hold circuit. Explain its operation. 7+7

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