



বিদ্যাসাগর বিশ্ববিদ্যালয়

**VIDYASAGAR UNIVERSITY**

**B.Sc. Honours Examination 2021**

(CBCS)

**4th Semester**

**PHYSICS**

**PAPER—C10T & C10P**

**ANALOG SYSTEMS AND APPLICATIONS**

*Full Marks : 60*

*Time : 3 Hours*

*The figures in the right-hand margin indicate full marks.*

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

**THEORY : C10T**

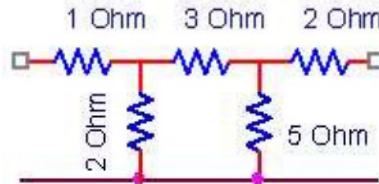
Answer any *two* questions.

2×15

1. (a) How is a transistor represented as a two port device ?

(b) Define the hybrid parameters for a basic transistor circuit in any configuration.

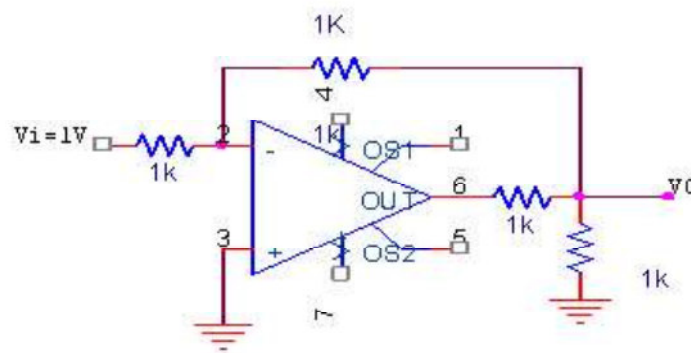
(c) Find the values of h parameters of the given circuit



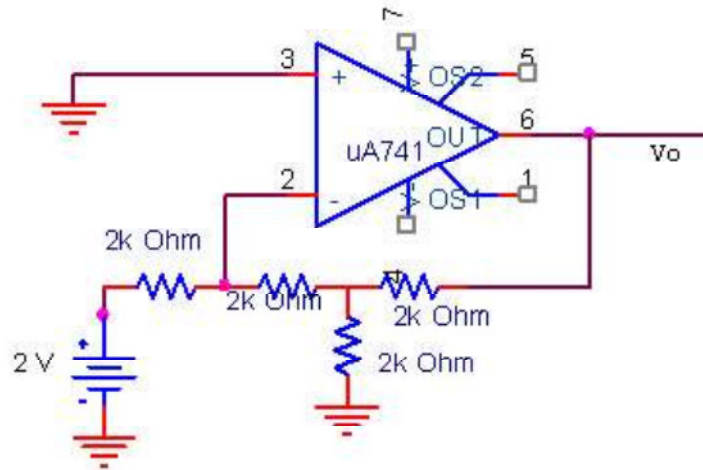
(d) What are the advantages of the h-parameters?

3+4+6+2

2. (a) In a differential amplifier using OPAMPs with two inputs the output is 2.01 mV when the inputs are 110  $\mu$ V and 90  $\mu$ V but the output is 2mV when the inputs are 10 $\mu$ V and -10  $\mu$ V. Find the CMRR of the amplifier.
- (b) Define slew rate. In an OPAMP the maximum current charging the corresponding capacitance of 30 pF is 200  $\mu$ A. What will be the slew rate of the OPAMP?
- (c) Find the output voltage of the figure given below.



(d) Determine the output voltage of the figure given below.



3+4+4+4

3. (a) Derive expression for mid and high frequency voltage gain of a R-C coupled amplifier.
- (b) The mid-band gain of a RC coupled amplifier is 120. At frequencies of 100 Hz and 100 KHz, the gain falls to 60. Determine the bandwidth.
- (c) Draw a circuit diagram of a 4 stage R-2R ladder D/A converter. Calculate the output voltage when input binary number is 1110 where reference voltage is 16 V and  $R = 10\text{K}\Omega$  and feedback resistance,  $R_f = 3R$ . 3+3+4+5
4. (a) Explain with the help of a block diagram the working principle of a feedback amplifier. Find out an expression for the voltage gain with negative feedback.
- (b) An amplifier has a voltage gain of  $-100$ . The feedback ratio is  $-0.04$ . Find
- The voltage gain with feedback
  - The amount of feedback in dB.

- (iii) The output voltage of the feedback amplifier for an input voltage of 40mV.
- (c) What are the Barkhausen criteria? What are the primary requirements to obtain steady oscillations at fixed frequency?
- (d) In a phase-shift oscillator that uses three RC sections,  $R_L = R = 10k\Omega$ . If the oscillator is to generate frequencies in the range from 1 to 100 kHz, what should be the range of capacitor, C.

(4+2)+3+(2+1)+3

Answer any *one* question.

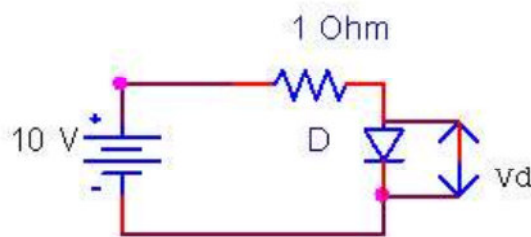
1×10

5. (a) An LED operates at 1.5V and 5mA in forward bias. Assuming an 80% external efficiency of the LED, how many photons are emitted per second?
- (b) A diode D as shown in figure has an i-v characteristic relation given by

$$i_d = v_d^2 + 2v_d \quad \text{for } v_d > 0$$

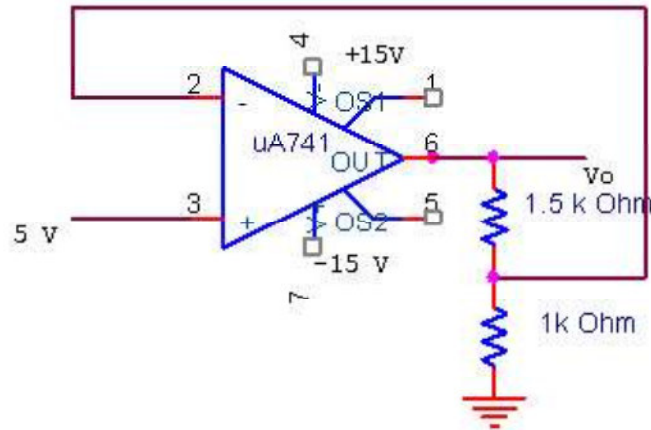
$$= 0 \quad \text{for } v_d < 0$$

Find the voltage across the diode,  $v_d$  in this circuit.



5+5

6. (a) Why is the field-effect transistor called a unipolar transistor? What is the significance of the term field-effect?
- (b) Determine the output voltage of the given circuit.



6+4

### PRACTICAL : C10P

Answer any *one* question.

1×20

1. Draw the circuit diagram for VI characteristic of Zener diode. Calculate the limiting resistance,  $R_S$  for Zener voltage = 5.6V, maximum wattage of Zener,  $P_{ZM} = 0.25W$  and maximum input voltage,  $(V_i)_{max} = 10V$ . Draw VI characteristic curve of Zener diode and specify the Zener breakdown voltage. How can you determine dc and ac resistance from characteristic curve? 3+7+4+2+4
2. Write down the theory and circuit diagram to investigate the use of an OP AMP as an integrator. Calculate the specific value of limiting resistance,  $R_2$  capacitor and other resistor( $R_1$ ) connected to inverting

input. Capacitance should be such that there would be limiting frequency,  $f_0 \sim 160\text{Hz}$ . Draw the nature of the plot  $\frac{V_i}{V_0}$  vs  $f$ . How can you determine unknown capacitor from this curve provided  $R_1 = 1\text{K}\Omega$ ?

6+7+3+4

3. Draw a circuit diagram to study characteristics of an n-p-n transistor in common emitter configuration. Write down the theory for this experiment. Draw the output characteristic curve. How can you determine the ac current gain ( $h_{fe}$ ) and output admittance ( $h_{oe}$ ) from the characteristic curve?

5+6+4+5

**[Internal assessment - 10]**

**[Attendance - 5]**

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