Comparator

- A comparator, as its name implies, compares a signal voltage on one input of an op-amp with a known voltage called the **reference voltage** on the other input.

- Basic circuit of a comparator using op-amp is shown in Fig. where a reference voltage Vref equal to 1V is applied at inverting input and a sinusoidal voltage Vin is applied at noninverting input.

- As it is shown in Fig. whenever Vin > Vref output goes to positive saturation voltage +Vsat because op-amp is working in open loop. Similarly when Vin < Vref output goes to negative saturation voltage – Vsat. Thus Vo changes from one saturation level to another whenever Vin = Vref.

- As it is evident from Fig. that an analog input voltage (sinusoidal voltage) is getting converted into a digital voltage (square wave) in the process of comparison, that's why comparator is termed a type of **analog-to-digital convertor.**

- At any given time the Vo waveform shows whether Vin is greater or less than Vref. Therefore comparator is sometimes also called **voltage-level detector.**

- In Fig. whenever Vin becomes too high from Vref then this high difference voltage may exceed the rating of op-amp and cause damage to op-amp. Therefore to protect the op-amp diode D2 is used because when difference voltage exceeds, D2 will clamp the difference voltage to 0.7 V.

- Similarly when Vin is too low from Vref, diode D1 will come into picture.

- That’s why D1 & D2 are known as *clamp diodes.*

- In Fig.(c) reference voltage has been taken as -1 V.

- Since in this circuit the voltage to be compared is applied at noninverting input that’s why this circuit is termed as *noninverting comparator*.

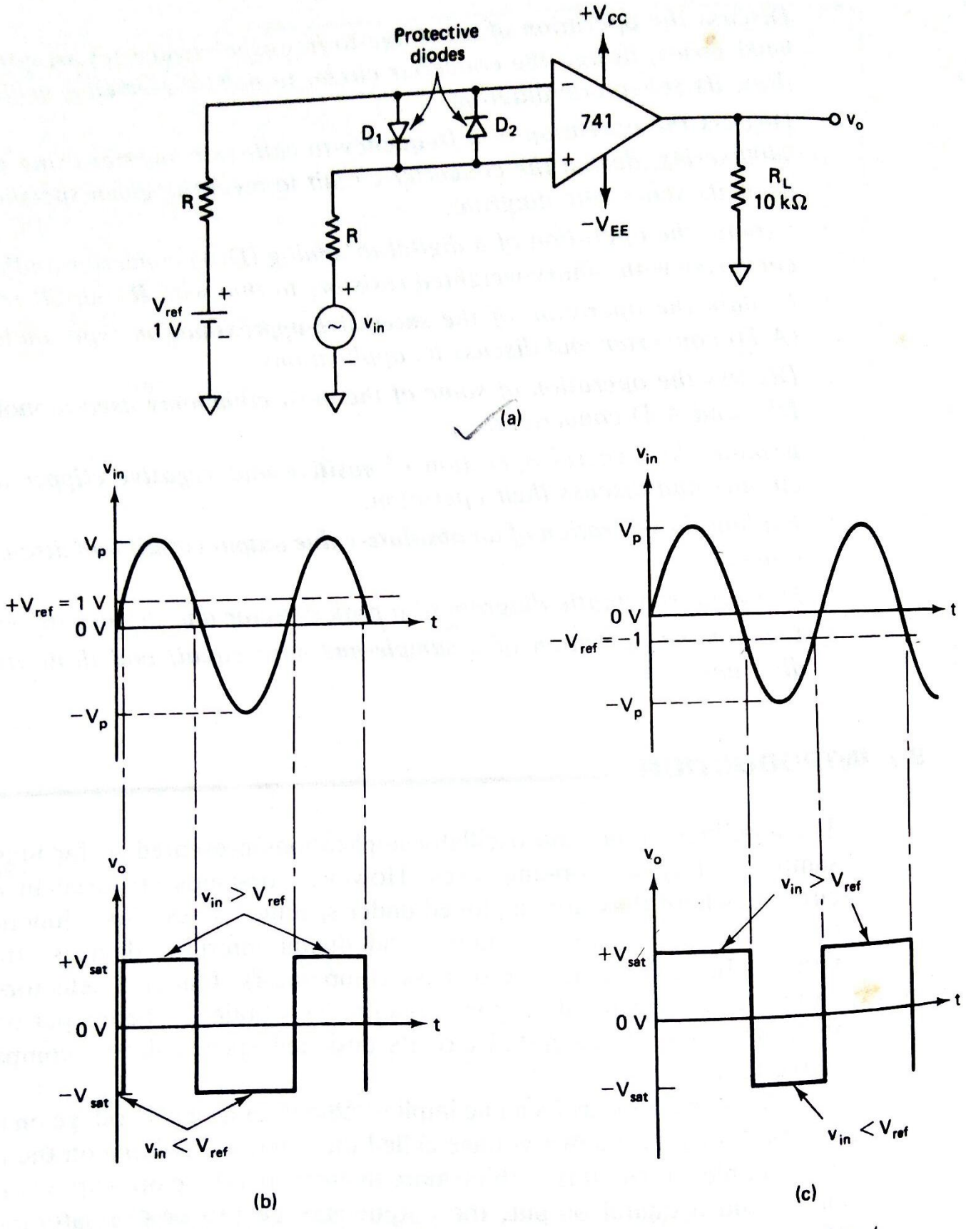

Fig: Noninverting comparator with input and output waveforms

- Following circuit shows an inverting comparator.

- In this circuit, Vref is obtained by using a 10-kΩ potentiometer that forms a voltage divider with the dc supply voltages + Vcc and – VEE and the wiper connected to the (+) input.

- The rest of the working is similar to noninverting comparator.

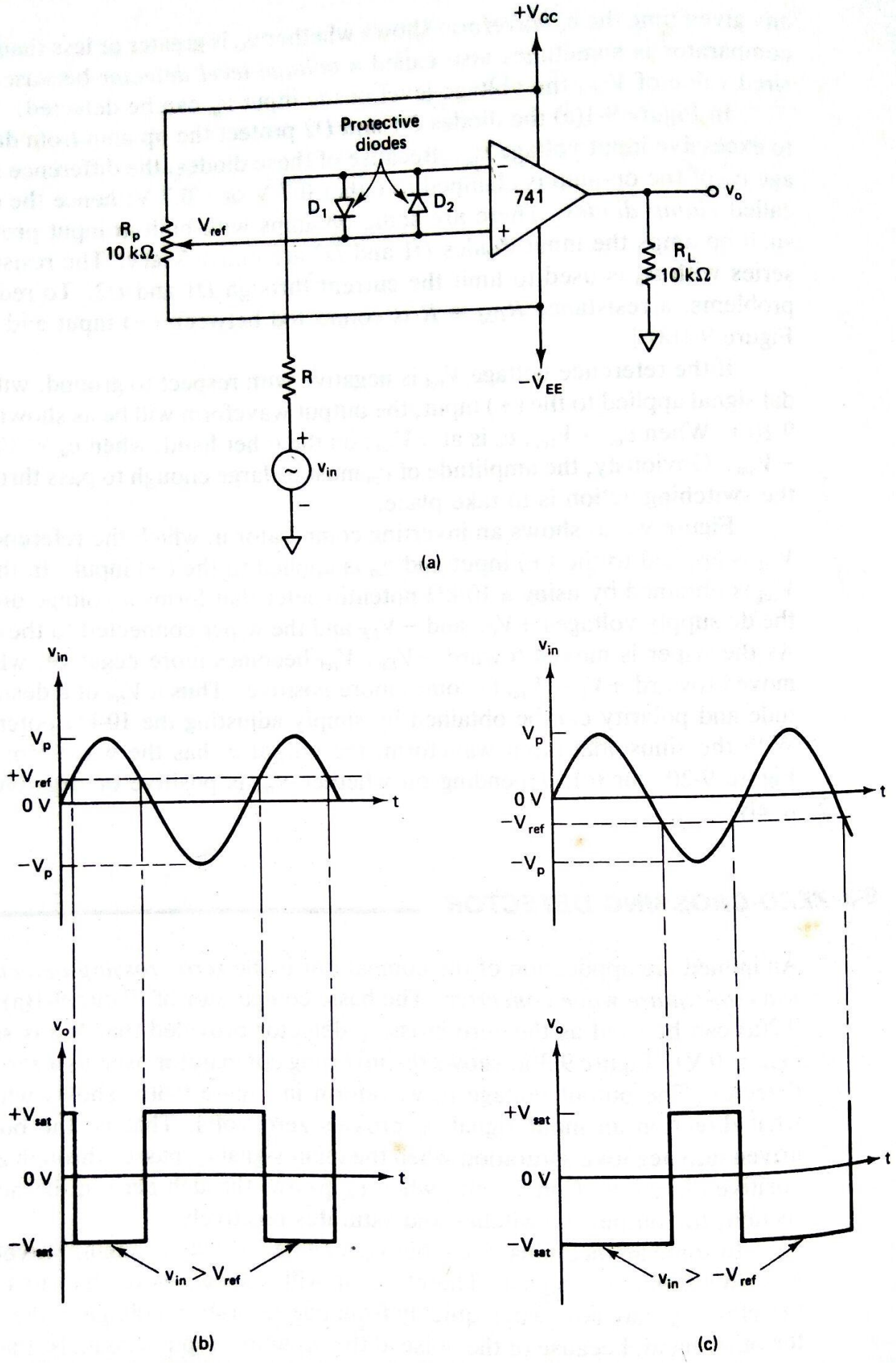

Fig. Inverting comparator with input and output waveforms

Zero-Crossing Detector

- If we set Vref = 0 V then the input voltage will be compared to zero volt and the corresponding circuit and waveforms will be as follows.

- This circuit is known as *zero crossing detector* or *sine- wave-to-square-wave convertor.*

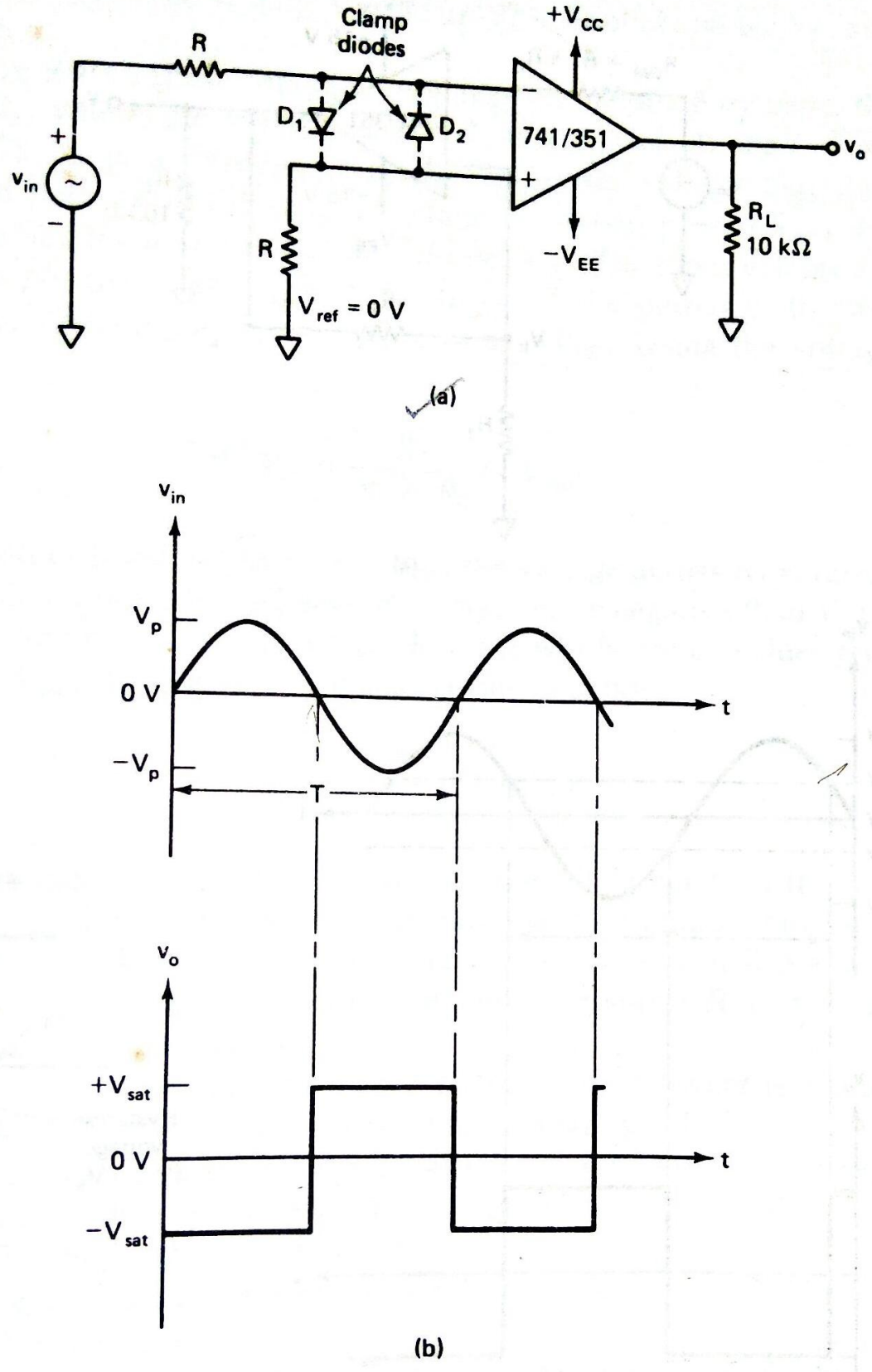

Fig: Zero crossing detector with its input and output waveforms